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School of Geography, Archaeology and Environmental Studies

Climate Related Societal Consequences and Responses during the 19th century, South Africa and Lesotho, 1830-1900

A dissertation submitted to the Faculty of Science in fulfilment of the requirements for the degree Master of Science

Shantal Beharie (Rampath)

29 May 2019, Johannesburg

Declaration

I hereby declare that this dissertation is my own original work, except where otherwise acknowledged. It is being submitted for the degree Master of Sciences to the University of the Witwatersrand, Johannesburg. I have not submitted this work in part or whole previously, for the purpose of obtaining any degree, qualification, or otherwise, at this or any other university.



Shantal Beharie

29 May 2019

Abstract

Documentary evidence and established chronologies for southern Africa contain rich sources of information on social and environmental impacts and consequences on past societies in southern Africa. The primary aim of this research is to use such established chronologies to determine the environmental and social consequences and relevant responses that followed such droughts and floods including ENSO years where possible. All relevant information was extracted from existing research as well as original data that had already been collected for such regions. The data used for this study involved collecting historical records from the various regions that reflected social and environmental consequences and responses from published historical projects. Such published projects contained 19th century climatic chronologies that were already established from raw primary data such as newspapers, journals, diaries, newsletters and government annual reports in order to make relevant associations between climatic events, societal impacts, consequences and responses. All qualitative data for impacts and consequences were also converted into quantitative data. The outcomes of the study revealed that the impact of droughts had a major impact towards livelihoods and resource availability for southern Africa. In comparing adaptive capacity across the regions, the data revealed that KwaZulu-Natal may have taken longer to recover from most of the impacts, while regions such as Namaqualand and Lesotho were shown to have shorter impact periods and quicker recovery times for certain impacts such as poverty and famines. Qualitative data also showed that various responses were undertaken to cope with such impacts. Coping mechanisms which included religious responses, such as rainmaking and prayer for rains were common throughout Lesotho and KwaZulu-Natal, while migration and transhumance practices were common the coping mechanisms in Namaqualand during droughts and resource shortages in the 19th century.

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List of Abbreviations

AHS	African Horse Sickness
CBPP	Contagious Bovine Pleuropneumonia
COP	Conference of the parties
ENSO	El Niño-Southern Oscillation
FAO	Food and Agricultural Organization
IPCC	Intergovernmental Panel on Climate Change
UNFCCC	United Nations Framework Convention on Climate Change
WMO	World Meteorological Organization

1 INTRODUCTION



1.1 Climate and society

Considerable research, presently being undertaken, places focus on human vulnerability to global climate change (see Ford *et al.,* 2006), as well as associated response by individuals, communities, national governments and the international committees such as Intergovernmental Panel on Climate Change (IPCC) (Kelso and Vogel, 2015). In the 19th and early 20th centuries, investigations pertaining to natural phenomena and climatic changes have been dismissed by historians as they were regarded as inadvertent occurrences which were unrelated to human history (Pfister, 2007). However, during recent decades, the interest in documenting and understanding the relationship between climate variability and societal response has grown, mainly due to the increasing concern of the effects of anthropogenic climate change, commonly referred to as 'global warming' (Diaz and Trouet, 2014). Climatic anomalies, coping strategies and response towards the latest debates on anthropogenic greenhouse gas warming have also sparked much interest, especially following the occurrences of severe disasters (Pfister, 2007). African historians and archaeologists have disputed the underlying processes such as societal transformation and pre-industrial societies, prior to colonial rule (Hannaford and Nash, 2016). Climate has been considered as an agent

of historical societal changes, and has been associated as casually being linked to "*development and collapse of state structures, prior to written records*" (Hannaford and Nash, 2016:371).

A topic of interest for a variety of disciplines has been the study and understanding of current and future climatic trends and variability (e.g. rainfall and temperature) and how this alters natural processes (MacKellar *et al*., 2014). However, such changing trends cannot be studied by focusing on current and future impacts alone (Grau-Satorras *et al.,* 2016). Understanding how past societies coped with climatic changes offers a more complete perspective by positioning current and future hazards with long-term historical processes (Grau-Satorras *et al.,* 2016). In addition, Haldon *et al*.(2018) highlight that many societies have progressed in locations in which the environmental conditions were difficult to control, and hence environmental problems contributed to the development of such societies. Societies also need to be understood as existing within specific socio-geographic surroundings upon which they impact and with which they cooperate and adapt to, as part of a changing feedback system (Haldon *et al.*, 2018).

Ford *et al*. (2006) argue that in order to understand how future climate change may affect communities, there is a need to acquire knowledge which concerns how specific communities experience and respond towards climate variability. Learning and understanding the historical context of past experiences to cope with climatic change, can present a more complete perception by situating current and future impacts with long-term historical processes (Pfister, 2010).It can further help prepare modern society to cope with probable anthropogenic climate changes of the future century (Diaz and Stahle, 2007). During recent years, research being undertaken on climate change adaptation has therefore shifted its focus away from the traditional model-based "predict and provide" approach (Adamson *et al*., 2018: 196), towards approaches which are based on social sciences. During the earlier years of historical climatology, climate impact analysis formed a key component of this type of research (Adamson *et al*., 2018). However during the late 1990s this type of research evolved into historical disaster research as disaster studies focused mainly on anthropogenic climate change with a focus on concepts such as vulnerability, resilience and adaptation (Adamson *et al*., 2018).

However, a major challenge to this type of work has also alluded to the fact that it is difficult to identify how climate will impact the use of natural resources or when it will prompt movement of people, or the role it may play with respect to social conflict (Kelso and Vogel, 2015). In

addition, details on the societal response to climate changes remain indefinite and additional studies are required in order to observe how humans have dealt with challenges of a changing climate (Cui *et al*., 2017). The value of such historical climate-society research is that it presents a bottom-up approach, which explores the vulnerability and resilience of societies towards climate variability and extremes, and how such societies may have framed responses and adapted to such challenges and phenomena (Hannaford and Nash, 2016).

The primary manner, in which historians have engaged with climate change adaptation since the 1970s, was through climate impact studies (Adamson *et al*., 2018). In the 1990s the issues of greenhouse gas warming as a contributing factor towards the impacts of climate and environmental change on humankind was highlighted (Pfister, 2010). In addition, these environmental impacts on the earth's system caused by complex biophysical and socio-economic effects are currently receiving much attention (Kelso and Vogel, 2007). Furthermore, the concern for climate change is receiving much political response in many countries around the globe. Such attention is well covered by the Intergovernmental Panel on Climate Change (IPCC) assessment reports, COP (Conference of the Parties) agreements which take place annually and are organized through the United Nations Framework Convention on Climate Change(UNFCCC) and development by the G8 (Adger *et al*., 2003; Kelso and Vogel, 2007; Sweijd *et al*., 2015). Specific concern is being given to the present anthropogenic –driven climate change, for which the study of past climate helps to provide an indication of the extent of change during recent decades or centuries (Watkinson *et al*., 2004).

The frequency and occurrence of extreme climatic events occur as a result of changing climate (Hales *et al*., 2003). Although climate change has a direct impact on natural weather patterns, its effects cascade rapidly through a variety of sectors (Chandrappa *et al*., 2011). The range of impacts across sectors includes scarcity of food, water, ecosystem degradation, disease outbreaks, impacts on human health, disruption to human settlements, infrastructure disruptions, and economic losses (Cash *et al.,* 2006; Chandrappa *et al*., 2011; Simatele and Simatele, 2015).Further impact results in deepened poverty levels which causes poor economic growth and increased levels of vulnerability (Laukkonen *et al*., 2009). The contribution of historical analysis towards the study of past societies and their interactions with climate and the environment therefore remains relevant for the 21st century, especially with recent debates about climate change and its impacts (Haldon *et al.*, 2018). Understanding how past societies coped with changing climate and mitigated their challenges can also assist policy makers to develop strategies that are more resilient and robust to address challenges of a changing environment (Haldon *et al.*, 2018).

1.2 Overview of historical climatology

Historical climatology is defined as a branch of climatology dealing with anthropogenic and natural documentary evidence, with reconstruction of climate and weather extremes and their impacts on people and the environment (Bràzdil, 2000; Ogilvie, 2010). It has contributed greatly towards all related aspects of weather and climate research (Kraker, 2000). Extended knowledge of inter-annual climatic variability during recent decades to centuries is important for providing a context for long-term climate change (Zhang and Crowley, 1989; Hannaford *et al*., 2015). For example, historical rainfall variability patterns provide an essential understanding of long-term changes in precipitation, its timing and dispersal (Nash *et al.,* 2015). The importance of historical climatology is also significant within the context of understanding climatic processes, environmental history (Pfister, 2010) and the interaction between humans and the environment (Glaser, 1996). Lamb (1995) identified that human history and past records of climate have sparked a remarkable indication of the relationship between the two. Historical records serve as a great resource to recover a direct, detailed idea of societal responses to climate change (Cui *et al*., 2017).

1.3 Documentary evidence

A historical source on climate is a document which contains units of information such as manuscripts, printed material (such as newspaper or books), diaries, logbooks, journals, pictures or artefacts (such as flood marks or inscriptions on houses) which refers to patterns of weather or descriptions of climate impacts (Bràzdil, *et al*., 2004). These historical records include descriptive data (depiction of weather spells)together with proxy data which are combined with observations in the cryosphere, chronicles of frost dates, droughts, famine, freezing/drying up of water bodies, snow cover, and phenological evidence (such as dates of flowering plants, early arrival of birds etc.) (Jones and Mann, 2004; Bràzdil *et al*., 2004).For many climate researchers, natural archives and historical documents offers indirect evidence and proxies of past climate variability which can be extracted for the study of past climate change (Kaufman *et al*., 2013), specifically for periods or regions for which there are no obtainable meteorological records (Nash and Endfield, 2002).

Fenby and Gergis (2013) have emphasized in their study that documentary material may provide a societal record of the impact of past climate in areas of Australia where observational paleoclimate data, for example tree rings, are limited. Pfister (2010) has further added that historical climatology is situated at the interface between climatology and environmental history and displays the following objectives:

- Reconstructing of weather and climate preceding the modern instrumental period,

- Investigation of past economies and societies to climate extremes and natural disasters and
- Exploring climate discourses.

Prior to instrumental data being available, documentary proxy evidence has been progressively used for the study of extremes during the last few centuries and for developing regional climate constructions (Rodrigo and Barriendos, 2007; Bradley and Jones, 1992). Cui *et al.* (2017) indicate that historical records have prompted studies on societal responses to climatic changes. Societal vulnerability to climate hazards depends to a great extent on factors such as cultural representation of the natural environment, the technological level, social systems, governance and political structures and the degree of preparedness to overcome such shocks (Pfister, 2007). Archaeological records of cultural changes present opportunities to examine how large, complex societies responded to persistent long term climatic changes (de Menocal, 2001). Paleo-climatic evidence also provides reasonable environmental circumstances which acts as potential drivers associated with major societal disruption in various parts of the world (Diaz and Trouet, 2014). Various research studies have shown/cited the historical climate impacts on society and some cases where society has adapted or coped with such impacts during various periods in history (Table 1-1).

Climate diaries also comprise of a unique set of materials for climate change research, as they can provide information on both past climate variability and the manner in which people live within and interact with climate (Adamson, 2015). The use of climate diaries can contribute towards current debates around climate changes (Adamson, 2015). Collection of ship logbooks are one of the largest and most underused sources of historical data containing a wealth of environmental and meteorological information pertaining to air and sea temperatures, air pressure, wind and clouds (Allan *et al*., 2016). In addition, ship logs, were also used as an important source to record wind force and wind direction (Kraker, 2006; Bernhardt, 2015). These ship logs served as record keeping for the safest and fastest routes to the overseas European colonies, and were of high value for reconstructing weather conditions (Kraker, 2006).

Old chronicles, diaries and travel journals serve as important sources of weather information (Kraker, 2006). These materials contained many negative perceptions of weather information; for instance, weather extremes such as flooding or severe storm surges were recorded and explained in much detail (Kraker, 2006). They may also contain detailed information on drought periods and its impacts on human activities as well as relevant information pertaining to human responses to droughts (Brázdil *et al*., 2018).Furthermore, long severe drought periods or frosty periods that led to food scarcity or famine and increased mortality were

noticed by the chronicler (Kraker, 2006). Extreme rainfall trends coupled with thunderstorms and hail were observed in addition to crop failures.

Annals, chronicles, memoirs and inscriptions are narrative sources that describe to differing degrees of detail mainly important weather/climatic anomalies (including droughts), most commonly, those that were outstanding from the point of view of human memory or their impacts on human society. They may contain specific information about periods without rain, dry weather or drought, reporting also the lack of water for different human activities, impacts on the everyday life of people, and various other socio-economic impacts or human responses to droughts.

1.4 Previous work undertaken on historical climate construction

In the African context, the historical role of climate emerged as an immediate response to the rise of droughts, such as for example the 1968-1972 droughts in the African Sahel, the twin famines in Ethiopia during 1972-1974 and 1984-1986, and again in the 1990s, and following the extended drought in southern Africa in the mid-1980s (McCann, 1999). According to Kaufman *et al*. (2013), climate reconstruction of past variability over space and time serves as an important means to better understand the fundamental causes of climate change. This will be important to prepare for and inform future changes combining both anthropogenic and natural drivers (Kaufman *et al*., 2013). Furthermore, historical climate reconstruction serves as an important means for providing and shaping an historical context for assessing the nature of 20th century climate change (Gergis and Fowler, 2009).

The work by Nash *et al.* (2015) in southeast Africa has shown that severe or multi-year drought events occurred on eight occasions during their 19th century study period (1836–38, 1861–63, 1865–66, 1868–70, 1876–79, 1883–85, 1886–90, and 1895–1900). The most severe of these drought spells was the drought of 1861–63 and the most prolonged was that of 1895–1900. The drought conditions impacted on food supplies and condition of livestock, as well as agricultural activities, while occurrences of social conflict and unrest in parts of Zululand were also noted in the study (Nash *et al*., 2015). Apart from drought periods discussed, the study also identified severe wet periods which fell during the years: 1847–49, 1854–57, 1863–65, 1879–81, 1890–91, and 1892–94 (Nash *et al*., 2015), which resulted in extensive flooding across the regions formerly known as Natal and Zululand. The impacts were also known to have caused severe damage to crops, damage to housing, and major landslides close to Pietermaritzburg (Nash *et al*., 2015).

Nash *et al.* (2019) further studied the impacts of droughts during these particular periods: 1861–1863, 1876–1879 and 1895–1897. The study areas for examining the impacts of such droughts included the present day KwaZulu-Natal, Lesotho, Malawi, and the southern Kalahari comprising of Botswana and South Africa (Nash *et al*., 2019). The findings of this study indicated that the drought experienced during the 1861-1862 rainy season has a severe impact to pasturage across the former Natal region (Nash *et al*., 2019).

As identified in the work by Nicholson (1989), northern Africa experienced a relatively humid period which persisted from the 1870s to the mid-1890s. Drought became a common occurrence affecting the Nile River as well as Lake Chad. Southern Africa for example, has also experienced periods when rivers, swamps and wells dried up, well-watered plains turned barren, and farmers as well as tribesman expressed concern about decreasing rainfall (Nicholson, 1989:48). The decline in rainfall had resulted in periods of severe droughts which persisted for almost two decades (Nicholson, 1989). These historical fluctuations and descriptions of rainfall patterns have much in common with those of recent years, such as the 20thcentury climatic patterns. Documentary evidence from southern Africa, particularly for the Kalahari region, covering parts of Botswana and Namibia, has further shown that the region was impacted by major droughts over the following periods: 1820–27, 1831–35, 1844–51, 1857–65, 1877–86 and 1894–99 (Nash and Endfield, 2002).

Kelso and Vogel (2007) reconstructed the climate during the 19th century for the Namaqualand region. Their study revealed that this region experienced drought or dry years as follows: 1682–1684; 1762; 1805; 1807; 1812; 1817; 1820–1821; 1825–1827; 1834–1836; 1844–1845; 1855–1857, 1860–1862; 1865–1868; 1874–1875; 1880–1883; 1893–1896 (Kelso and Vogel, 2007). In contrast wetter years include: 1818; 1822–1823; 1831; 1859; 1872; 1878; 1888, 1899 and1900 (Kelso and Vogel, 2007). Further discussion and reference to this Namaqualand study is made in chapter 2.

Reconstruction of past climate becomes important for providing a historical context for evaluating the nature of historical climate change (de Menocal, 2001; Gergis and Fowler, 2008). There were extensive natural climatic fluctuations in the past; therefore, the importance of observing historical climatic records draws on important lessons which have been learnt about how societies respond to climatic change over time (Barnes *et al*., 2013). This type of climatic reconstruction serves to not only be useful in the interest of climate change, but seeks to provide a broader and improved understanding in environmental changes as well as the consequences thereof (Kelso and Vogel, 2007). A long-term perspective on pre-modern history serves as a fundamental means to grow understanding of past societal responses to

various climate extremes (Grau-Satorras *et al.,* 2016). Oldfield and Alverson (2003) further mention that climatic variability is a critical factor influencing societal stability.

1.5 Previous historical studies focusing on social impacts and adaptation

Various previous historical studies have been undertaken that have looked at the impacts of climate change on society (see Table 1 1). Such studies provide a good overview in terms of past situations, impacts and societal responses. In addition, some of these studies also looked at the context of various cultural reactions of such impacts. The study by de Menocal (2001) specifically highlighted the ability of past societies to cope with longer multi-century scale climatic changes during the late Holocene in the United States. Societies responded to such changes through the adoption of different subsistence modes, whereas smaller, sedentary populations often resettled into newer areas suitable for agricultural production (de Menocal, 2001). Other techniques of adapting included grain storage and water reticulation methods which were used as a buffer against inter-annual rainfall variations in Mesopotamia (de Menocal, 2001). The research conducted by Turney et al. (2006) also looked at human responses in Ireland to climate changes during the Holocene, which included subsistence strategies to cope with, and adapt to a changing climate.

Regional comparisons were undertaken by Brooks (2006) in the Central Sahara, Egypt, Mesopotamia, South Asia, northern China and coastal Peru to determine the trajectories of socio-cultural and environmental changes amongst these six key regions. The findings of this study reveal that in Egypt, during drought and desiccation, societies have abandoned the deserts, and lifestyle changes included change from pastoralism to more sedentary lifestyles were common (Brooks, 2006). During periods of long droughts and increasing aridity, urbanization was particularly rapid in northern China (Brooks, 2006). More recent work by Gerrard and Petley (2013) describe coping mechanisms during the period 1000-1500 AD (Middle Ages) in Europe against various environmental hazards. During the agrarian crises reported in 1315-1322 in Netherlands, the country lost between 5-10% of its population due to severe floods in 1313 and 1315, and the famine of 1314-1317 (Gerrard and Petley, 2013). It appears that some mitigation measures taken during this period involved the government lowering taxes on food import during disasters, tax relief funds for poverty stricken communities, distribution of food supplies and infrastructure repairs during floods (Gerrard and Petley, 2013). Other flood mitigation measures reported in Portugal during 1330, were raising of floor levels inside buildings and in arid environments during droughts. Sharing water was a common practice in Spain amongst agrarian communities (Gerrard and Petley, 2013).

Adamson (2014) studied government responses to past drought in western India during the 19th century.

Some significant case studies in the South African and African context, to name a few, are discussed in the work done by Kelso and Vogel (2007). Kelso and Vogel (2015) focused specifically on Namaqualand, Hannaford (2018) on the Zambezi-Save, southern Africa and Nash et al. (2019) on southern Africa. Although the study by Kelso and Vogel (2007) focuses on the climate of Namaqualand, elements of human vulnerability have been mentioned, such as harvest failures, loss of wheat and community distress amongst the poor during drought and dry years of the 1800s (Kelso and Vogel, 2007). Specific references are also made to hunting as an alternate source of food security during long, continued droughts, while other forms of adaptation were in the form of government interventions through food relief (Kelso and Vogel, 2007).

Table 1-1: Previous Studies Looking at Historical Impacts on Society, Coping and Adaptation

Authors	Year of Article	Time Period	Location	Type of Record	Type of Reconstruction indices/impact discussed in the paper	Documented Societal Responses
Vogel	`1993	1980s	Bophuthatswana	Documentary	Drought Poor water supplies Loss of livelihoods (livestock and maize)	• Food Relief measures • Prayer
Brázdil and Durdáková	2000	16th-18th centuries	Czech Lands	Archival sources	Effect of weather on grain prices	• Establishment of community funds for grains
De Menocal	2001	Late Holocene	United States	Various proxy data (tree ring chronologies)	Drought-water availability	• Population migrations, • Adapting new modes of subsistence,
Qian and Zhu	2001	1880-1998	China	Documentary and ice core data	Major drought	• No societal responses mentioned
Turney *et al.*	2006	Holocene	Ireland	Oak chronologies/radiocarbon ages	Changes in the latitude and intensity of zonal atmospheric circulation across the region (Sustained wet conditions)	• Development of subsistence strategies, • Construction of forts,
Brooks	2006	6th and early 5th millennia BP	Central Sahara, Egypt, Mesopotamia, South Asia, northern China and coastal Peru	Archaeological and Palaeo-environmental data	Extreme dry periods Extreme wet periods Monsoon systems ENSO cycles	• Livelihood strategies (increased sedentism and greater mobility) • Lifestyle transformations (mobile cattle

Authors	Year of Article	Time Period	Location	Type of Record	Type of Reconstruction indices/impact discussed in the paper	Documented Societal Responses
						pastoralism to ones suited to a more sedentary existence)
Diaz and Stahle	2007	Pre-Hispanic, colonial and modern era	America	Documentary	Natural Disasters/Hazards, Prolonged droughts,	• Cultural shifts as a response
Kelso and Vogel	2007	19th century (climate reconstruction)	Namaqualand	Documentary	Droughts Drought correspondence with the El Niño Southern Oscillation Wet spells	• Hunting-consumption of bulbs and roots during drought, • Selling of cattle to overcome debt, • Government relief works set up for mission station residents to earn income,
Xiao *et al*	2013	1644-1911	North China Plain	Documentary	Floods and droughts	• Government disaster relief • Inter-regional migrations
Gerrard and Petley	2013	1000-1500 AD (Middle Ages)	Europe	Documentary	Environmental Hazards (Earthquakes, Volcanoes) Severe weather (storms, flooding, lightning)	• Prayer was a response to hazards, • Flood measures • Sharing of water resources, • Government food relief measures, • Various religious responses such as

Authors	Year of Article	Time Period	Location	Type of Record	Type of Reconstruction indices/impact discussed in the paper	Documented Societal Responses
						pilgrimages, protective cults)
Adamson	2014	1790-1860	India	Documentary	Droughts	• Government Intervention comprised of the purchase and sale of grain and a ban on an exportation of grain from famine areas • Famine relief measures • Cultivators "borrowed" quantity of stock • Move away from traditional adaptive measures (agricultural variety and a prioritization of subsistence grains), towards the production of non-food crops
Adamson and Nash	2014	1781-1860	Western India	Documentary	Monsoon Variability	• No societal responses mentioned
Rocklöv *et al*	2014	1749-1859	Skellefteå, northern Sweden	Digitized aggregated population data and monthly temperature and rainfall	Change in seasonal climate	• No societal responses mentioned
Kelso and Vogel	2015	19th century (Livelihood Adaptations)	Namaqualand	Historical documentary records (Travel writings, missionary correspondence and	Droughts and dry periods, Poverty and distress	• Transhumance, • Consolidation of control of land.

Authors	Year of Article	Time Period	Location	Type of Record	Type of Reconstruction indices/impact discussed in the paper	Documented Societal Responses
				journals, colonial government reports and newspapers)		• Introduction of agriculture, • Cattle dispersion during severe droughts,
Izdebski *et al*	2015	200-800 AD	Eastern Mediterranean	Pollen analysis, archaeological evidence, and the historical evidence of subsistence crises	Climatic Changes (Droughts/Wet phases) leading to water scarcity/famines	• Water conservation during droughts included: modification to consumption locations, pursuit of alternative sources of water via aqueducts and construction of large-scale water storage mechanisms,
Grau-Satorras *et al*	2016	1605-1710	Terrassa, Spain	Archival research/documents	Droughts	• Symbolic drought rituals • Improvement of old infrastructure • Sewage works • Institutional responses (enforcement of flexible sanctions, defence of community water rights, regulating the use of water)
Ye *et al.*	2016	19th century	North China	Historical documentary analysis	Natural disasters (floods)	• Government relief (food) • Flood relief rescue,

Authors	Year of Article	Time Period	Location	Type of Record	Type of Reconstruction indices/impact discussed in the paper	Documented Societal Responses
						• Dredging of channels to prevent and mitigate flood impacts
Guevara-Murua *et al*.	2018	1640-1945	Pacific coast of central America	Historical documentary analysis	Societal responses to droughts and floods	• Rogation ceremonies to pray for rain • Preventative annual dredging prior to annual rains
Hannaford	2018	1505-1830	Zambezi-Save, southern Africa	Historical documentary analysis	Droughts	• Mining of gold, iron and copper in exchange for grain during famine, • Hunting and gathering of wild food
Camenisch and Rohr	2018	Little Ice Age (1300-1850)	Europe	Application of various concepts and models used in previous research	Climate extremes Impacts on food prices, harvest sizes, famines	• Religious rituals, • Migrations
Nash *et al*	2019	19th century (1861-1862, 1876-1879 and 1895-1897)	southern Africa	Historical documentary records (Newspapers, letters, reports, diaries and journals)	Droughts Impacts to pasturage, impacts to food supply, delayed planting,	• Prayer for rains, • Population dispersion • Eating of wild food to stay alive, • Rain-control and rainmaking,

1.6 Research rationale

Climate has always varied in the past and will continue to, more so because of anthropogenic impacts which influence the earth's atmospheric composition (Karl and Trenberth, 2003). The emphasis on the science of climate change has often overshadowed work on societal impacts and responses (e.g. adaptation, resilience, cultural coping strategies) (Allan *et al*., 2016). The value of historical-climate-society research entails an understanding of human vulnerability and resilience, and how past societies framed, responded to and adapted to various climatic phenomena (Hannaford and Nash, 2016). Societal responses are also mediated by culture which plays a role in framing climate change as being a phenomenon which is a concern to society (Adger *et al.,* 2012). Several studies (see Table 1-1) have examined past societies and how they coped with change, whilst examining their resilience and vulnerability to certain hazards and climatic impacts across different regions in Europe, America, southeast Africa and China..

This research will also focus on major (extreme) climate events (drought and floods) in the study regions during the 19th century and examine associated societal consequences and responses to these extremes, with a specific focus on how these may have varied both spatially and temporally between 1830 and 1900.. What is important to note in this context is that while there is mention of El Niño and La Niña events in the context of this study, El Niño and La Niña impacts are inseparable from the broader issues of climatic variability and change, including social and economic development (Adeel and Glantz, 2001). Hence, in undertaking this study, this must be taken into consideration for the broader assessment.

ENSO events are significant and are known to influence rainfall over large parts of sub-Saharan Africa (Nicholson, 2001). Kripalani and Kulkarni (2012) highlight that drought and flood conditions can occur due to external climatic forcing such as El Niño/La Niña events. The direct impacts of ENSO events on the study regions may be limited, and not all extreme climatic events are necessarily associated with ENSO. It is therefore important to consider ENSO effects and shed light on some of the problems which may have been experienced in association with such events, and any lessons learnt from societal responses. Understanding that action is required to enhance the adaptive capacity of the most vulnerable societies and groups, this research is focused on recognizing generic factors of resilience, coping, adaptation as societal responses.

1.7 Knowledge gap

Historical climatology plays a significant role towards the understanding of climate processes, prior to human interference on the global atmosphere (Bràzdil *et al*., 2004). Reliable historical climate datasets are vital for accurate trend and variability analysis as well as for validation of regional and global climate models, and for detection and attribution of climate change (Vincent and Gullett, 1999). Various historical climate research studies have been undertaken in southern Africa (example: Namaqualand, Kalahari, KwaZulu-Natal, the Cape, Lesotho, Madagascar) (Nash and Endfield, 2002; Kelso and Vogel, 2007; Nash and Endfield, 2008; Nash and Grab, 2010; Nash *et al*., 2015; Kelso and Vogel, 2015). The work done by Kelso and Vogel (2015) explored livelihood adaptations of the Namaqua Khoikhoi using an environmental history approach on the Leliefontein community in Namaqualand, Northern Cape region. In an earlier study, Kelso and Vogel (2007) provided a 19th century climate chronology for Namaqualand, with specific reference given to temperature and rainfall and a detailed assessment of wet/dry periods. Other expansion of climate history in the region includes the work by Grab and Nash (2010), which presents a 19th century cold season climate chronology. However, a regional comparison of what each of these studies has achieved becomes an interesting topic of discussion. Comparing regions over time and exploring the different ways in which people within these regions were coping with or adapting to these consequences, provides for an interesting topic yet to be examined.

1.8 Aims and objectives

This research aims to use 19th century climate chronologies already established for southern Africa, and in accordance, determine the environmental and societal consequences and responses that followed droughts and floods. In doing so, this research will provide a comparative analysis of societal consequences and actions across sub-regions to compare such consequences and responses (such as copying and adaptation mechanisms) across the various spatial contexts in southern Africa – this has not previously been undertaken for the region. This will be achieved by addressing societal responses and coping strategies as the human element, and climatic impacts as the scientific element.

1.9 Research questions

In framing the research questions for this study, various studies for southern Africa were looked at. Although the spatial dimensions of climate may have differed across each of these regions, the impacts that were felt were severe. Each region's climate characteristic differed, for example: the climate of Namaqualand was described as a semi-desert area, while regions such as the Karoo and Kalahari are semi-arid. The Karoo is prone to regular droughts, while

the Kalahari also experiences high rainfall variability. The Karoo and Namaqualand regions are also similar, in that they both occur in the winter rainfall zones compared to the Kalahari and KwaZulu-Natal which are in the summer rainfall zones. Each of these regions is unique, however these studies have been selected as they offer the opportunity to compare and contrast historical climate events across a variety of source materials. In addition to this, the cultural dynamics of each of these regions are rich and each climate issue would be felt and interpreted differently in some of these regions. Some source materials in these regions will also report events differently, and this offers a unique opportunity to explore and compare differences across regions.

In framing the context for this study, the study will be guided and informed by the following set of research questions which will form the basis for the chapters of this report.

1. Using existing recorded data for historical droughts and wet periods; what were the climate extremes during these years and what significant impacts were recorded about these climatic extremes across various regions of southern Africa?
2. What were some of the societal consequences of these impacts across various regions of southern Africa for common periods?
3. By investigating societal consequences, how long did certain types of consequence's last for?
4. By comparing the various sub-regions of southern Africa; what are the different recovery periods for these regions?
5. Is it possible to identify and separate coping and adaptation mechanisms during the 19th century in southern Africa?

The research will also emphasise what some of the consequences and societal responses during this period were in light of the climatic events. In addition, the study will draw on how society in these regions was adapting to and coping with specific climatic events during ENSO years and years immediately following, as opposed to years relatively unaffected by ENSO. The research objectives for this Masters project will thus include the following:

1. To understand what the impacts of these events were during the period 1830-1900, not only on livelihoods, but on broader sets of issues such as health, risks, illnesses, epidemics, migration, poverty, economic impacts, and environmental degradation, to name a few.
2. To identify how society was responding to and coping with these impacts as a result of extreme climatic events and to establish, where possible, any challenges experienced while trying to adapt/cope.

3. To contribute towards understanding historical climate change adaptation through sharing lessons learnt, as well as to establish ongoing research gaps.

1.10 Dissertation outline

This dissertation is structured into seven chapters which include the introduction to the study which provides some background to concepts such as climate and society, describing what is documentary evidence and historical climate. It also presents a clear rationale for the study and the aims and objectives for this research.

Chapter 2 presents an overview of the five study regions in southern Africa (KwaZulu-Natal, Karoo, Kalahari, Namaqualand and Lesotho) which this research focuses on. It provides a historical context for each region in terms of livelihoods, agriculture, climate and past climate that was reconstructed, and it paves a way for the socio-economic context for the various regions in relation to how they coped with past climate changes, resource variability and decline of livelihoods.

Chapter 3 presents a detailed literature review in the context of this study. The literature review frames historical research that is relevant to societal impacts and consequences. Classes of climate impacts are further discussed to draw attention to consequences. Literature on impacts that were relevant to the 19th century that happened elsewhere worldwide were also cited as examples. In addition, examples of coping and adaptation were also looked at to determine the different mechanism adopted in relation to impacts.

Chapter 4 presents a detailed outline of the methods that were used in undertaking this research. It talks about the different data that was used from published work, which has been undertaken in the various study regions as well.

Chapter 5 draws on the findings of this research and presents a detailed analysis of the results. The various themes include human health impacts, crop pests, environmental impacts (droughts, flood and famines), livestock diseases, social impacts, and coping/adaptation.

Chapter 6 presents a discussion chapter which focuses on key findings from this research.

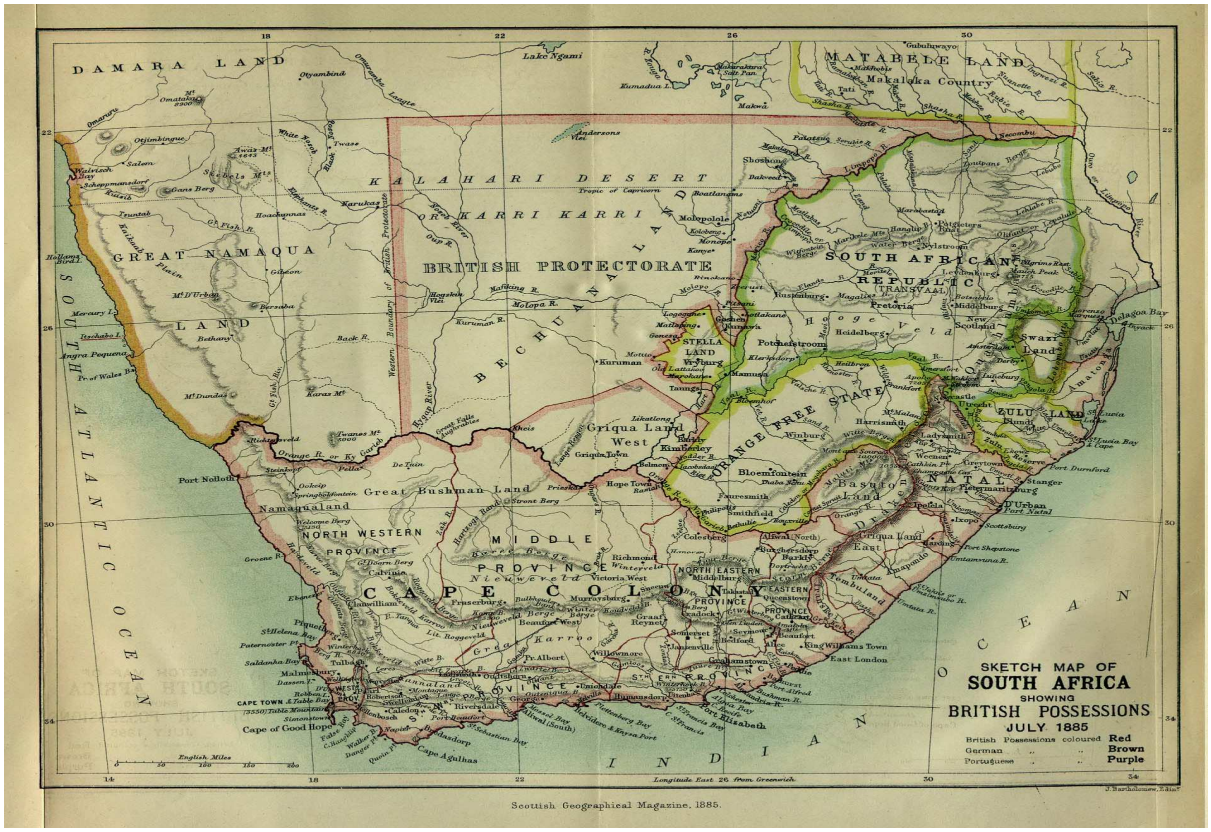
Chapter 7 is the conclusion chapter which summarises this study and provides a holistic summary of the findings of the study.

1.11 Conclusion

This chapter presents an overview of climate in relation to society and how climate changes have become affiliated with societal changes. Early climate debates began in the 1990s (Pfister, 2010) in which specific concern was given to anthropogenic influences to climatic changes (Watkinson *et al*., 2004).The chapter also reflects on paleoclimatic reconstruction methodologies which aided in weather observations (Bradley and Jones, 1992). Examples of various research studies which mentioned historical climate impacts on society as well as means of coping and adaptation are presented.

The chapter also provides a clear vision of why this research is being undertaken and why it is important to consider societal risks and consequences caused by climate change. The knowledge gap is identified in published work by Nash and Endfield (2002), Kelso and Vogel (2007), Nash and Endfield, 2008; Nash and Grab, 2010; Nash *et al*., 2015; Kelso and Vogel, 2015,) which focused on reconstruction of climate chronologies in various regions. There is opportunity to look into the societal risks, consequences, adaptation and coping whilst comparing the different regions from a spatial perspective to understand how the different regions responded when faced by harsh climatic conditions in the past.

2 ENVIRONMENTAL SETTING OF THE STUDY REGIONS



2.1 Introduction

This chapter outlines the historical background of South Africa and provides a historical context for various southern African sub-regions. It describes the socio-economic background, climate and natural environments, and forms the historical context to which this research then draws links to. Furthermore, this chapter will also provide a context for the study covering the periods 1830-1900. Kelso (2010) argues that detailed recording of environmental histories of people groups in South Africa provides a better basis for understanding the relationships between people and their surrounding environments.

Noteworthy interest has been shown in African environments with particular attention being made towards degradation of natural environments, depletion of natural resources and land degradation (Krokfors, 1995). The nature and rate of environmental changes (both natural and man-induced) have resulted in multiple environmental problems including growing populations, scarcity of energy resources, diseases, food and clean water provision, new forms of land degradation and climatic changes, which are amongst the most common issues

(Krokfors, 1995; Green, 2013). Different systems of agricultural production suited the environmental conditions that people faced (Green, 2013). Other limiting factors that affected agricultural and livestock were rinderpest outbreaks, affecting livestock and locust invasions which affected crops (Green, 2013).However, within the African landscape, the relationship to environmental resources has shown a wide variety of adaptive strategies as well as means of coping with environmental stresses and changing climates (Krokfors, 1995). Migration is one important demographic response to poverty and environmental stress in the African environment (Krokfors, 1995). This is further discussed below.

2.2 Climate, Society and Environment of the Study Regions

2.2.1 Namaqualand

Namaqualand is situated on the west coast of South Africa, extending from the Orange River in the north to Vanrhynsdorp and the Olifants River in the south (Davis *et al*., 2016) (Figure 2-1). The region is characterized as a semi-desert area, displaying a highly variable climate and experiences frequent droughts (Kelso, 2010). The regions were historically referred to as the district of Little Namaqualand in the Cape Colony while the present day Namibia (across the Orange River to the North) was referred to as Great Namaqualand (Kelso, 2010). Namaqualand takes its name from the Nama-speaking Khoekhoen herders (Rohde *et al*., 2003). The ancestors of these herders engaged in the pastoral expansion in southern Africa about 2000 years ago and as such have inhabited the Atlantic coastal region of southern Africa since then (Rohde *et al*., 2003). Some historical and archaeological artefacts of European contact with the KhoiKhoi in Namaqualand reveal that the Namaqua people were groups of pastoral people, who were fairly mobile in large groups (Rohde *et al*., 2003). Such movements were directed by the availability of grazing land, water and controlled to a large extent by seasonal and climatic variation (Rohde *et al*., 2003).

The rainfall season for Namaqualand is mainly during winter, but occasionally rainfall occurs during summer months (Kelso, 2010). The area receives most of its rainfall (66%) during austral winter months (Dewar and Stewart, 2016). The north experiences less than 50mm of mean annual rainfall while the peaks of Kamiesberg receive up to 400mm of rainfall, annually (Dewarand Stewart, 2016). During the last 2000 years, the dominant land use activity in Namaqualand has been pastoralism (Cousins *et al*., 2007).

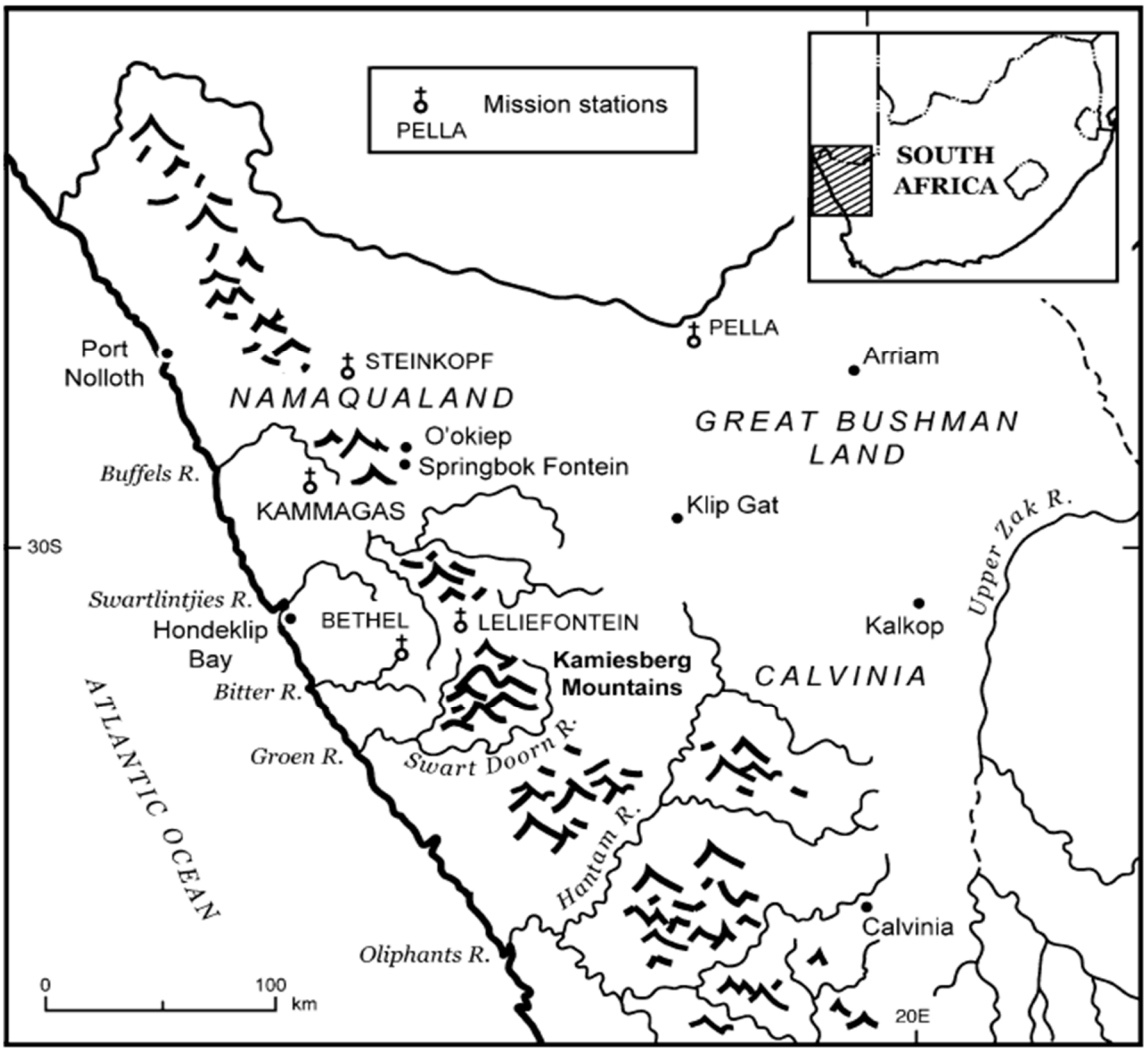


Figure 2-1: Map of Namaqualand(Source: Kelso and Vogel, 2007:359)

Namaqualand contains approximately 3500 plant species, with 25% of this flora being endemic to the region (Davis *et al*., 2016). The Succulent Karoo biome, inclusive of the Namaqualand region is recognized globally as a biodiversity hotspot which is highly vulnerable to climate change (Davis *et al*., 2016). This is not due to the high levels of biodiversity present in this region, but also due to high dependence of the region's population on natural resources, production of livestock, and dryland agricultural activities (Davis *et al*., 2016). Land use practices in the region have always been influenced by the climate of the region, particularly rainfall and temperature (Rohde and Hoffman, 2008). Rainfall is a key driver of ecosystem functioning and human responses in the region and different land use practices have influenced the landscapes of Namaqualand over the last 100 years (Rohde and Hoffman, 2008).

2.2.2 Climate context for Namaqualand during the 19th century

The Namaqualand area in the Western Cape Province displays a desert climate, experiencing high diurnal and seasonal temperatures (Kelso, 2010). Kelso and Vogel (2007) reported that much of the Namaqualand region is prone to droughts. Droughts usually extend over a few consecutive years and this has deteriorating negative impacts as it continues (Kelso and Vogel, 2007). Recurrent droughts during the 1870s and 1880s resulted in the decline of livelihoods of the inhabitants especially within the Leliefontein community (Rohde *et al*., 2003). Such livelihood decline caused crop failure and loss of livestock leading to dismissal of reserve labourers from surrounding commercial farms (Rohde *et al*., 2003). Draught oxen became scarce due to such droughts, and in this instance relief food had to be collected from surrounding areas by the inhabitants themselves (Rohde *et al*., 2003). The drought resulted in a decline in cattle numbers from 2500 in 1860 to 1400 in 1890 (Rohde *et al*., 2003).

Kelso (2010) described that in addition to climate changes, other significant drivers of livelihood changes in Namaqualand during the period 1800-1853 included missionary influences, introduction of agriculture, variations in the structure of livestock, and transhumance routes. All of the above drivers have created long term pressures which weakened the livelihoods of the Leliefontein Namaqua population which have made them even more susceptible, and inclined towards the harsh effects of climate changes (Kelso, 2010).

Kelso and Vogel (2007) developed a climate reconstruction for the Namaqualand region during the 19th century (Figure 2.2). The work done by Kelso and Vogel (2007) focused largely on the central Kamiesberg Mountains due to the fact that this area was home to one of the oldest mission stations namely the Leliefontein station were data was available for a longer period of time for this area (Kelso and Vogel 2007). The dry years that have been reported for Namaqualand during the 19th century include the following years: 1805; 1807; 1812; 1817; 1820– 1821; 1825–1827; 1834–1836; 1844–1845; 1855–1857, 1860–1862; 1865–1868; 1874– 1875; 1880–1883; 1893–1896., whilst in comparison to the wetter years, which were reported for the following periods: 1831; 1859; 1872; 1878; 1888, 1899 and 1900 (Figure 2-2) (Kelso and Vogel 2007).

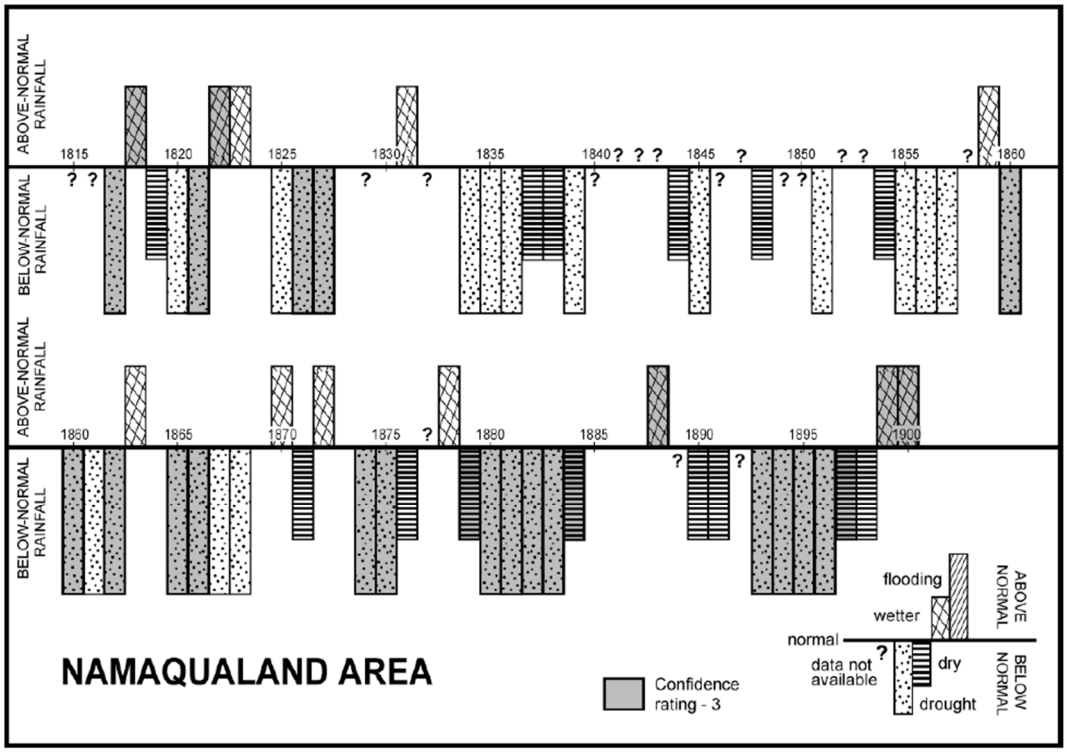


Figure 2-2: Climate for Namaqualand during 1800s (Source: Kelso and Vogel, 2007; Kelso, 2010)

Transhumance across the area is an essential part of the pastoral system due to spatially and seasonally unpredictable rains (Rohde and Hoffman, 2008). Such practices of pastoral grazing strategies developed in northern and eastern Africa, and later spread to southern Africa (O'Farrell *et al*., 2009). Seasonal transhumance continued throughout the 19th century, until the practice became increasingly constrained and less adjustable to climatic variability (Rohde and Hoffman, 2008). During 1850, mission stations in Leliefontein were divided into outstations which were divided within demarcated areas for seasonal grazing lands (winter and summer) (Rohde and Hoffman, 2008).

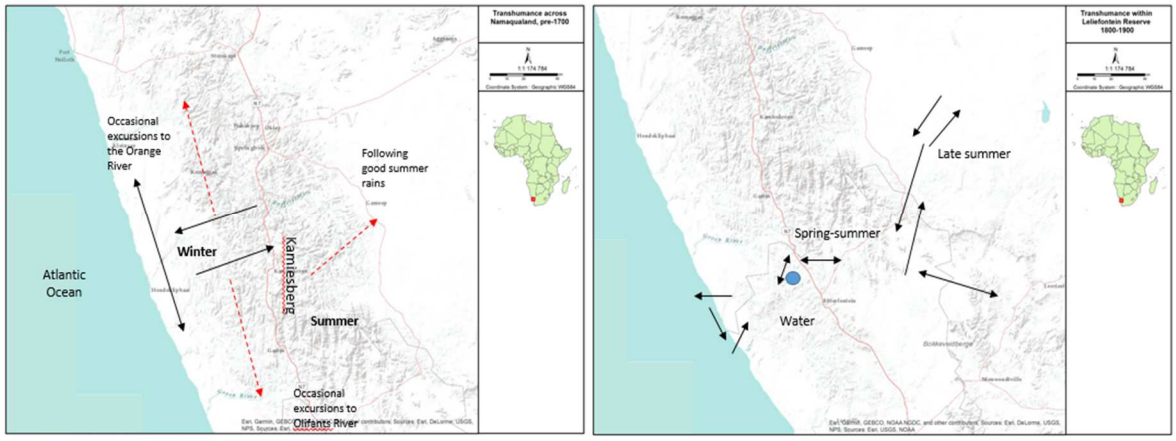


Figure 2-3: Transhumance routes of Nama livestock keepers Namaqualand during pre-colonial 1700 and Leliefontein Reserve 1800-1900(Adapted from: Rohde and Hoffman, 2008:196)

The Transhumance routes in Namaqualand (Figure 2-3), also varied yearly for the Namaqua Khoikhoi (Kelso, 2010). Transhumance often took place in the summer, in the Kamiesberg mountains which was rainfall dependent (Kelso, 2010). These mountains were situated at higher altitude which has higher rainfall, thus making it a suitable and adequate location for transhumance during summer (Kelso, 2010).

2.2.3 Socio-economic background

The main population group within the Namaqualand region is the Namaqua Khoikhoi, the San were regarded as separate groups of people who also resided in Namaqualand and often related to the Namaqua Khoikhoi during the 18thand 19th centuries (Kelso, 2010). The Namaqua Khoikhoi were nomadic pastoralists, and regularly moved with their cattle in search for adequate grazing lands (Price, 1976; Cousins *et al.,* 2007; Kelso, 2010). In cold winter months, people trekked to the lower, more temperate areas (Price, 1976). The Namaqua were involved with smelting of metals (copper); herding of domestic stock; hunting; gathering and exchange relationships as livelihoods (Kelso, 2010).

The missionaries played an influential role on the Namaquas, in that they promoted cultural and livelihood changes that was related to education, crop production, and construction of buildings that were more permanent rather than mat huts which were favourable to migration during times of distress (Rohde *et al*., 2003). The route of migration was reliant on rainfall and pasturage (Price, 1976). In addition, the missionaries also tried to settle groups that were scattered in Leliefontein by introducing agriculture (Price, 1976). Agriculture was further supported through the erection of iron forages, building of ploughs, and the missionaries showed the Namaqua people how to plough lands and plant seeds (Price, 1976). Vacant lands were used for growing crops such as wheat, barley and rye which were a success (Price, 1976). The Namaqua people learnt how to farm and manage their land and stocks, all because of missionary influence. By the 1870s land for agriculture and stock farming, for conducting mixed farming, became an important asset for the Namaqua, on which they depended for their livelihoods (Price, 1976).

The coloured communal areas were seen as important social and administrative features of the Namaqualand landscape (Rohde and Hoffman, 2008). They started as mission stations and were seen as places of refuge from the violent, oppressing effects of frontier colonialism (Rohde and Hoffman, 2008). During a much later period, these communal areas were converted into labour reserves for the commercial farming and mining welfares (Rohde and Hoffman, 2008). Leliefontein and Paulshoek are areas comprising widely dispersed villages,

whilst Paulshoek is surrounded by 20,000 hectare of communal grazing land (Rohde and Hoffman, 2008).

Until the late 19th century, grazing practices were migratory and although seasonal transhumance continued throughout the 19th century it gradually became restricted and less adjustable to seasonal climatic changes (Rohde and Hoffman, 2008). The missionary lands in Leliefontein during 1850 were divided into different outstations and separate internal divisions within the areas delineated for winter and summer grazing lands (Rohde and Hoffman, 2008). Recurrent droughts events during the 1880s and 1890s had a negative impact on the fortunes of the Leliefontein community resulting in socio-economic consequences such as livestock losses, crop failures, hardships and destitution (Rohde *et al*., 2003). In order to cope with the droughts, which was compounded by legislation which tried to control and reform communal institutions, such example included the introduction of house taxes in 1878 (Rohde and Hoffman, 2008). The house taxes tried to privatize communal lands during 1890 and the formation of government control over mission stations.

2.2.4 Growth of the mining industry

During the 1950s copper mines were established in Namaqualand, which became a dominant feature of the economy within the region (Rohde *et al*., 2003). The copper mines have been intricately intertwined with the history and economy of Namaqualand during the past century, which at the time attracted more people to the region (Ross, 1998). The mining sector being labour-intensive, demanded a large workforce which comprised of Africans from all over the colony and beyond (Lawrence, 1994). Such mining related activities grew and flourished in camps and provided employment for increasing numbers of both black and white populations (Lawrence, 1994). The copper mining industry became the second most important export for the Cape colony (Rohde *et al*., 2003).The inhabitants of Leliefontein comprised of mixed farmers during this period, owning large numbers of cattle, wagons and horses (Rohde *et al*., 2003). Water transportation played an essential part in the growth of Namaqualand, and in the advance of the copper mining industry (Ross, 1998).

The prosperity of Namaqua inhabitants increased during the mining period, allowing them the opportunity to utilize their wagons and oxen as a means of transport for the mine workers (Rohde *et al*., 2003). These developments went hand in hand with the expansion of the cash economy (Rohde *et al*., 2003). Rohde *et al*. (2003) also reported that some of the Namaqua were reluctant to work on the mines and reported to have suffered outbreaks of typhoid fever during the 1870s. In addition, alcohol abuse became a widespread problem. Due to the Namaquas and Basters being reluctant to work in the mines, a number of people from different

races were employed, in 1869 the count was 144 Europeans and 624 “blacks” of different ethnic backgrounds being employed at the mines (Rohde *et al*., 2003).

Exports increased until the 1880s and the mines remained a profitable part of the Namaqualand economy (Rohde *et al*., 2003). As early as 1874, the Spektakel mine outputs decreased and this resulted in poverty for the region. In 1888 the world demand for copper reduced rapidly, and the price of copper around the world continued to fall until 1919 (Rohde *et al*., 2003).

2.2.5 Droughts and decline

Namaqualand is an area that was well known for experiencing droughts, with the latter half of the 19th century and early 20th century experiencing severe droughts that crippled the economy in Namaqualand (Price, 1976). The inhabitants of Leliefontein declined rapidly during the 1870s and 1880s due to recurrent droughts (Rohde *et al*., 2003). The most significant drivers of change during the period 1800-1853 were the influences of missionaries, the introduction of agriculture, changes in livestock structures, transhumance routes, and an invasion of Dutch farmers that were permanently settled in Namaqualand (Kelso, 2010). Severe droughts were reported during the period 1881 and 1883, which resulted in many crop failures, decline in the health of oxen and livelihood failure (Rohde *et al*., 2003; Kelso, 2010). In addition, dismissed reserve labourers from neighbouring commercial farms were forced to leave Leliefontein to work on the construction of roads (Price, 1976; Rohde *et al*., 2003). During the 1880s the transport trade was highly dependent on draught oxen (Rohde *et al*., 2003). When transport became scarce, it resulted in food having to be collected from areas such as O’Kiep by the reserve inhabitants (Rohde *et al*., 2003). The decline in cattle from 2500 in 1860 to 1400 in 1890, was attributed to the droughts and cattle being traded for transport (Rohde *et al*., 2003). During the copper boom in the 1860s, men from Leliefontein sold their cattle for transport riding (Price, 1976). The physical resources of the reserve deteriorated, and this was caused by overgrazing of land, crop failures and population growth (Price, 1976). As a result, people were forced to look outward for other sources of income. Droughts reported in 1895 resulted in dependency on external economies for survival (Price, 1976). Areas such as Cape Town attracted migratory labour which resulted in further loss of labour in the Namaqua reserve and a lack of investment (Price, 1976).

2.3 Lesotho

Lesotho is a landlocked country, bordered by mountains displaying an area of 30, 355 km² and is completely surrounded by South Africa (Maro, 2011) (Figure 2-5). It is often referred to as the “Switzerland of Africa” or the “Mountain Kingdom” (Prah, 1989). The country and its

surrounding regions are semi-arid to sub humid and display a continental climate with wet, warm summers and dry cold winters (Grab and Nash, 2010). Lesotho is divided into four agro-ecological regions (Figure 2-4) which include: the Lowlands, Foothills, Senqu River Valley and Mountains (Maro, 2011; Letsie and Grab, 2015). The people of Lesotho have displayed a long history of adapting their livelihood to ever changing hostile circumstances (Turner *et al*., 2001).

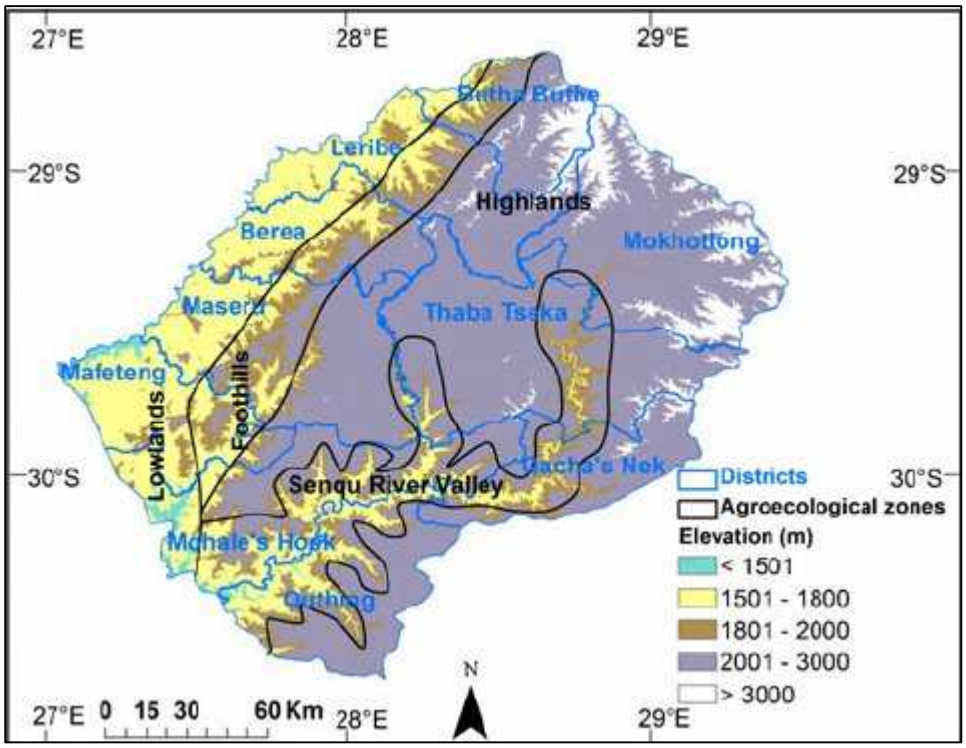


Figure 2-4: Agro ecological Zones of Lesotho (Source: Moeletsi and Walker, 2012)

Stock grazing is highly favoured over growing of crops due to the mountainous terrain of the country as well as its rich farming culture (Maro, 2011). The Lowland region has short mild winters and long hot summers, whilst the mountainous region experiences harsh winters, and short cool summer periods (Maro, 2011). The Senqu river valley region experiences mild winters and warm summers which is highly favourable towards the growing of winter wheat (Maro, 2011). Rainfall in the region is of great importance for food security (Hydén and Sekoli, 2000).



Figure 2-5: Map of Lesotho(Source: Grab and Nash, 2010:475)

2.3.1 Climate context for Lesotho during 1825-1900

The climate context for Lesotho has been derived from documentary sources by Nash and Grab (2010) (Figure 2-6). It was reported that a total of nine periods were drier than normal conditions, and these years included: 1833–34, 1841–42, 1845–47, 1848– 51, 1858–63, 1865–69, 1876–80, 1882–85 and 1895–99 (Nash and Grab, 2010). The earliest drought episode began during the first half of the 1833-43 rain years (Nash and Grab, 2010).

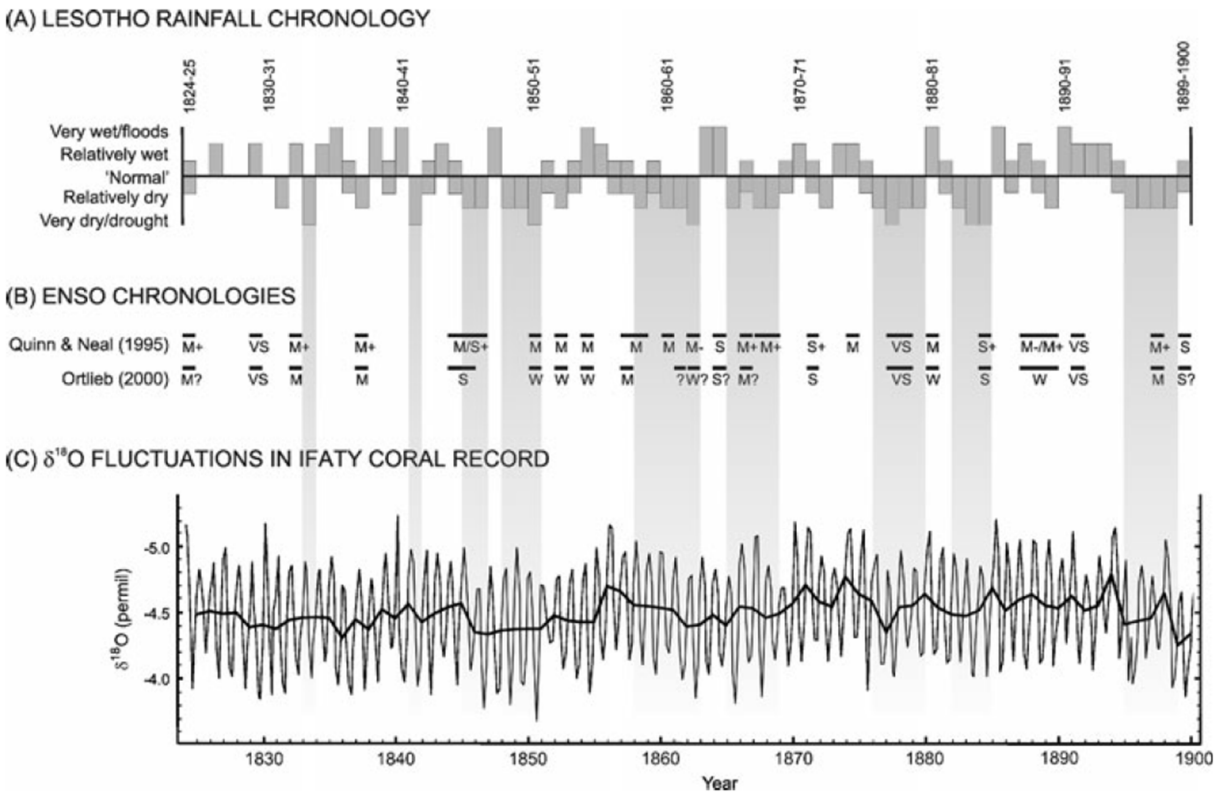


Figure 2-6: Documentary derived rainfall chronology in Lesotho for 1824-25 and 1899-1900 (Source: Nash and Grab, 2010:626)

Some qualitative observations made by Grab and Nash (2010) for Lesotho during this period included weather events such as snowfalls, frost, ice, hail, rain, fog, wind, storms as well as general descriptions of environmental conditions such as river levels, and crop conditions. The focus on river intensities was often described as impacts of flooding, river levels, and the extent of ice (Grab and Nash, 2010). Weather severity had an impact on vegetation and crops, as described in some of the data, whilst some records indicated prevalent snow, frost and damage to fruit trees (Grab and Nash, 2010). General climate and weather descriptions includes “mild seasons”, “more severe than previous winter” as well as impacts of climate on humans and livestock conditions (Grab and Nash, 2010).

2.3.2 Socio-economic background

The people of Lesotho are known as the Basotho, founded by King Moshoeshoe in 1818 (Maro, 2011). The Basotho people comprised of warriors, hunters and herdsman and their traditional forms of occupation includes: leather making, metal and glass works, pottery and weaving (Maro, 2011). In addition they were traditional pastoralists and subsistence farmers (Kishindo, 1993). One of the most important agricultural activities in Lesotho is crop production (Mokitimi, 1990). The major crop grown in Lesotho prior to 1833 was sorghum (Mokitimi, 1990, Kishindo, 1993), however under the French missionary influence, who started arriving in 1833,

the Basotho began growing other crops such as maize and wheat (Kishindo, 1993). Wheat was used as a trade crop with neighbouring European settlements (Kishindo, 1993). Division of labour was gender based and men were primarily involved with cattle herding whilst the women produced food crops (Kishindo, 1993). Missionaries arrived in Lesotho at the request of Moshoeshoe and they were sent by the Paris Evangelical Missionary Society (PEMS) (Maliehe, 2014). The missionaries were involved with promoting individual property rights of individual producers in order for the Basotho to reap the benefits of the product of their labour (Maliehe, 2014). In addition the missionaries altered the established economic and political formations of the Basotho by promoting the commoditization of production (Maliehe, 2014).

The demand for Basotho grain grew sharply with the discovery of diamonds in the Orange Free State in 1867 and the opening of gold mines in the Transvaal in 1886, events which resulted in heavy population concentrations and development of towns (Kishindo, 1993). In response to the demand for grains, the Basotho farmers brought more land under cultivation which increased the demand for labour (Kishindo, 1993). Farmers were encouraged by missionaries to adopt ox-drawn ploughs and by the 1870s the ox-drawn ploughs replaced the hand hoe for cultivation (Kishindo, 1993).

During the 19th century, Lesotho was a net exporter of grains and this was mainly for mining camps of South Africa (Mokitimi, 1990). Maro (2011) highlighted that in the early1800s inter-tribal war and severe droughts affected the region which resulted in social conflicts between tribes for pasture lands and fertile cropping areas. The impact of severe droughts resulted in theft of cattle and grain which led to severe famine and cannibalism in some parts of Lesotho (Maro, 2011). Towards the end of the 19th century grain prices fluctuated because of climatic conditions as well as grain tariffs which were imposed by the South African government on Lesotho grains.

2.4 The Kalahari

The Kalahari is a vast arid ecosystem of southern Africa (Radatz, 2003). The region is situated within the southern African summer rainfall zone (Thomas, 2002). The Kalahari experiences low but variable rainfall and some tribes such as the San had adapted to such environments (Radatz, 2003). The Kalahari has been used as domestic grazing grounds for centuries and is currently separated into grazing lands which are overstocked, leading to degradation (Radatz, 2003). As compared to much of southern Africa, the Kalahari experiences a semi-arid climate with evident seasonality and high rainfall variability (Nash and Endfield, 2002).

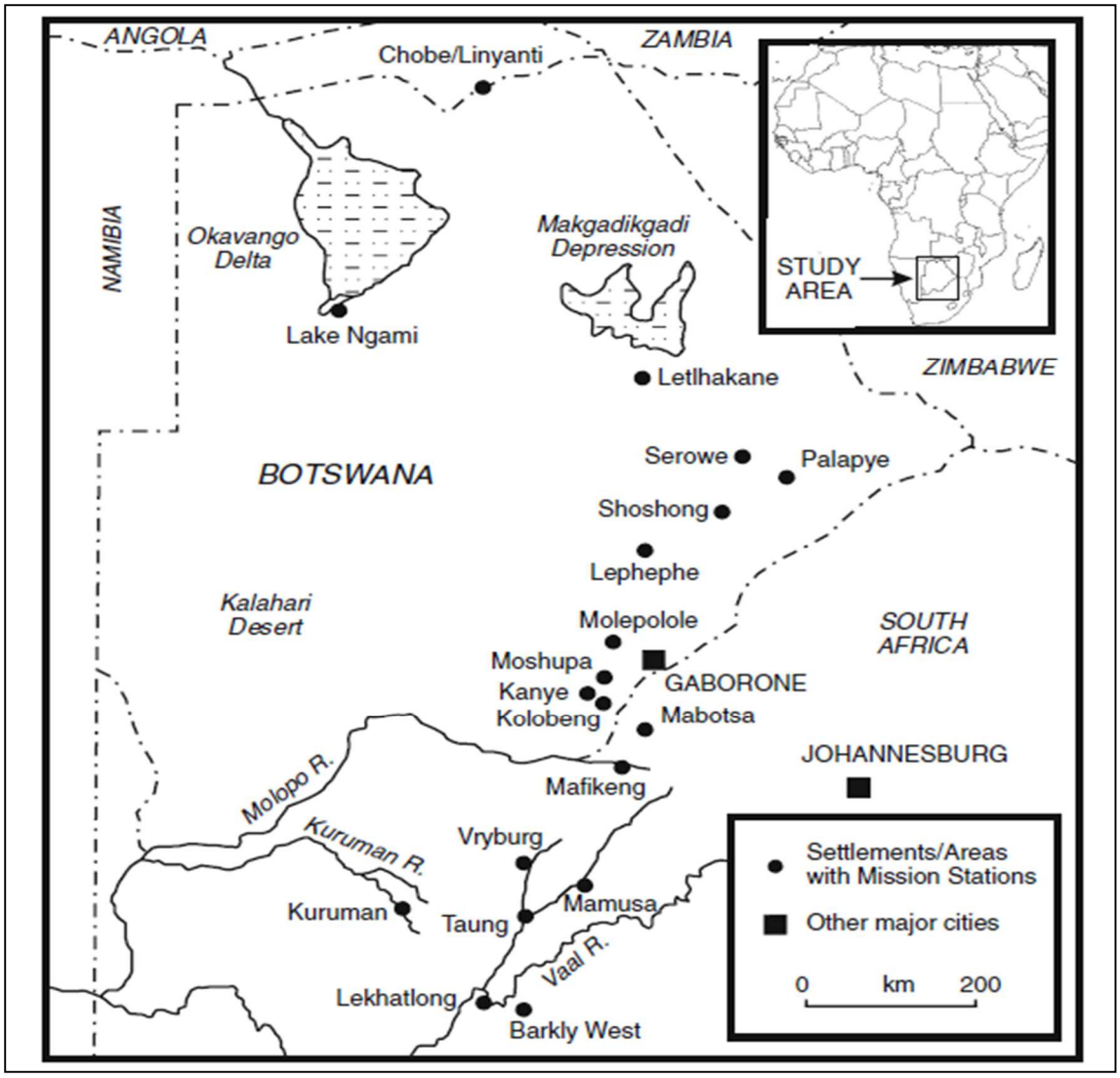


Figure 2-7: Kalahari Desert and Location of Mission Stations(Source: Nash and Endfield, 2008)

2.4.1 Climate context for the Kalahari during the 19th century

Nash and Endfield (2002) developed a climate chronology for the Kalahari region. The major drought periods for the region included the following years: 1820–27, 1831–35, 1844–51, 1857–65, 1877–86 and 1894–99 (Nash and Endfield, 2002). The most widespread drought periods were in the following years: 1844–51, 1857–65, 1884–86 and 1894–99 (Nash and Endfield, 2002). The extent of impact affected areas such as Barkley West in South Africa, Lake Ngami and Serowe in Botswana (Nash and Endfield, 2002). The major dry phases that were apparent for the region during the record period affected the Kuruman region between 1820 and 1827 and between 1831 and 1835 (Nash and Endfield, 2002). It was further pointed out by Nash and Endfield (2002) that the dry nature of the country has been stressed in the context of the climate around Kuruman and that often the climate is based on comparisons with other countries, which experience a more temperate climate. Periods of drought coincided with the timing of moderate to strong ENSO events (Nash and Endfield, 2002).

Wet phases were also identified with notable wet periods affecting various parts of the Kalahari being recorded as follows: 1816–17, 1829–30, 1851–52, 1863–64, 1874–75, 1889–91 and 1899–1900 (Nash and Endfield, 2002). During 1889-91, the most widespread wet conditions occurred and these were coupled with severe storm and flood events which affected mission stations across the entire region, including other parts of South Africa (Nash and Endfield, 2002). It was further noted that the wet phases were of relatively shorter duration than dry phases. Periods of heavy rainfall in the Kalahari resulted in considerable disruption to communication between the different mission stations and descriptions of environmental conditions such as water levels were also mentioned (Nash and Endfield, 2002). Wet phases of 1874-75 were considerably more widespread and affected areas that were far apart, for example Shoshong and Taung, mentioned by Nash and Endfield (2002).

The research by Nash and Endfield (2002), further alluded to the fact that many early counts of climate and environment within the Kuruman area signified a generally dry nature of the country. The extended natures of droughts experienced in various regions of the Kalahari were often illustrated by various missionaries in the region (Nash and Endfield, 2002). The noted consequences reported were livestock health that was deteriorating due to droughts, failure of crops, delayed and very little ploughing, food scarcity, and social distress (Nash and Endfield, 2002). Some indication was drawn to the fact that the droughts spread beyond regions of the Kalahari.

2.4.2 Socio-economic context of the Kalahari

The Kalahari Desert comprises mainly of Bantu speaking inhabitants or Khoisan speaking people (Silberbauer and Logan, 2017). During the late 18th century, Tswana population spread west from the Limpopo basin into the northern and eastern Kalahari (Silberbauer and Logan, 2017). The first arrivals of Europeans to the Kalahari was during the 19th century who entered as missionaries, travellers, traders and hunters (Silberbauer and Logan, 2017). Housing in the region was mainly traditional which is described as single roomed huts comprising of mud walls with thatched roofs (Silberbauer and Logan, 2017). A limiting factor for the region is water resources which was confined to settlements which were situated closer to boreholes with potable water supplies (Silberbauer and Logan, 2017). According to Thomas (2002), groundwater tables in the Kalahari have notably decreased since the 19th century. The lack of vegetation and land degradation of the Kalahari has made the soil highly erodible (Radatz, 2003).

The basis of the economy within the region is cattle, which are often kept on the borders of the villages (Silberbauer and Logan, 2017), however Radatz (2003) argues that cattle

herding contributed to the degradation of the Kalahari landscape. The density of cattle herds was often seen as problematic and as the grass cover decreases, the rates of erosion remain high and cattle outputs per head decrease (Radatz, 2003). In addition, pasture loss and desertification are major pressures that threaten the ecology of the Kalahari Desert (Silberbauer and Logan, 2017). Other risks towards livestock include droughts, diseases, parasites and wild predators (Silberbauer and Logan, 2017).

Cultural practices have resulted in a change in nomadic herdsmanship and certain tribes such as the Bechuana and Batau created their own means of nomadic pastoralism (Radatz, 2003). The use of fire as a grassland management tool was widely practiced (Radatz, 2003). Similar to that in Namaqualand, transhumance practices evolved in the Kalahari and allowed cattle to enter marginal parts of the Kalahari during resource scarcity (Radatz, 2003). According to Thomas (2002), much of the Kalahari is deemed unsuitable for cultivation and wild plants including roots, bulbs, berries and tubers are a source of food for rural people; in addition these plants are also used for medicinal practice. Whilst Silberbauer and Logan (2017) described that the impacts of drought in the region have also contributed to increasing failure of crops which resulted in wild food being consumed as part of the diet.

2.5 The Karoo Region

The Karoo region is described as a semi-arid area of approximately 400 000 km² and is situated within the central and western interior of South Africa (Figure 2-8) (Nel *et al*., 2007; Water Research Commission, 2017). The region receives less than 350mm of rainfall annually (Water Research Commission, 2017). The climate of this region is characterized by hot and dry conditions, however regular droughts are experienced in this region which hampers farming (Farmers Weekly, 2014). The Karoo is considered as a single ecosystem, which is divided into the winter rainfall Succulent Karoo and the summer rainfall Nama Karoo (Nel *et al*., 2007). The region experiences limited water availability and depleted grass reserves which render the region unsuitable for cattle keeping (Farmers Weekly, 2014).



Figure 2-8: The Karoo region (Source: Nel *et al*., 2007:5)

The economy of the Karoo is dominated by rangeland agriculture and the urban areas are isolated and developed to service the farming, religious and administrative needs of the dispersed farming communities (Nel *et al*., 2007). During the 19th century, pastoral activity in the Karoo dominated the national economy and production (Nel *et al*., 2007). During this period, the Karoo region was regarded as being the economic hub of the country (Nel *et al*., 2007). However, the following century of droughts, war, industrialization and urbanization has made the region into a harsh, degraded desolate landscape (Nel *et al*., 2007).

2.5.1 The Rural Economy of the Karoo

The towns of the Karoo region were established during the 1700s and through much of the 1800s, with many of these towns described as “church towns” which serviced the farming communities (Toerien, 2017). Before the discovery of minerals in the 1860s and 1880s the economy in South Africa was controlled by expanding pastoral farming in the Cape Colony (Nel *et al*., 2007). Land was allocated by a lease system to the farmers in the semi-arid interior

of the Karoo. During 1825, it was discovered that 2500 ha of land was insufficient for commercial pastoralism in the Karoo, as such authorities allowed the allocation of land to increase up to 12 500 ha in the Kalahari (Nel *et al*., 2007). The economy of the country in 1870 was dominated by agricultural and pastoral resources that were originating from the Karoo, particularly sheep wool which was critical to the growth and development of the industrial revolution in Britain (Nel *et al*., 2007; Nasson, 2010; Toerien, 2017). Over periods of time, the demands for wool by the British industrial economies grew intensely (Nel *et al*., 2007). This led to strengthening of production, investment and the introduction of barbed wire and windmills which enabled intensive production and new animal breeds that were resilient to arid conditions such as merino sheep and angora goats (Nel *et al*., 2007). The growth in sheep numbers grew substantially between 1845 and 1911 (Nel *et al*., 2007). The Karoo region benefited from diamond and gold during the 1870s and 1880s, however factors such as droughts, overgrazing, economic decline and South African war resulted in long term declines in the economy which began in the early 20th century (Toerien, 2017).

2.5.2 Social Background to the Karoo

The first inhabitants of the Great Karoo were known as the 'Hottentot' (as called *Khoikhoi, Khoekhoe, Khoenkhoen*) and the hunter-gatherer 'Bushmen' (also called *San, Soaqua, Sonqua, Sono-qua*) (Kruger, 2013). These hunter gatherer communities co-existed in the southern and Western Cape regions (Mckenna, 2011; Kruger, 2013). The Khoikhoi were widely spread and ensured that they had access to water, whilst access to natural resources such as soil and land for grazing was fairly limited (Kruger, 2013). Factors such as war, diseases, and absorption into the Cape Coloured communities have resulted in the original Khoe groups being dissipated (Mckenna, 2011). The traditional economies and social structures of the Khoe have changed drastically; formerly their way of life was based on herding, hunting and gathering (Mckenna, 2011). With industrialisation and introduction of western cultures, the majority of Khoe have settled and have adopted material, equipment, dress, language and generated a living off Europeanised rural environments (Mckenna, 2011). The San on the other hand, lived off animals which they hunted using bows and arrows, snares and traps and wild collected food such as roots, fruit, wild vegetables, lizards, insects, and locusts (Kruger, 2013).

2.6 KwaZulu-Natal

The KwaZulu-Natal, formerly known as Natal, coastal belt is described as a narrow zone of land which is approximately 240km long (Christopher, 1977). The region comprises of three marked sub regions which includes: the coastal plains, the granite lands and the interior plateau (Christopher, 1977). KwaZulu-Natal is described as the wettest province of South

Africa with rainfall along the coast exceeding 1300mm per annum (Nash *et al*., 2015) and the driest area being the north-western part (Ellis, 1998). However rainfall can be unpredictable and display seasonal distributions (Ellis, 1998). Zululand lies on the south-eastern coast of Africa between the Drakensberg Mountains and the Indian Ocean (Knight and McBride, 1989). The landscape is described as steep rolling grassland, from cool inland heights to a sub-tropical coastal strip which is intersected by many river systems (Knight and McBride, 1989). There was an abundance of thorn bush which grew in abundance in the valleys and countryside, and game such as antelope, wildebeest, elephant and lion thrived well (Knight and McBride, 1989). Cattle played an important role in Zulu culture and were not just seen as an asset but as a source of food and rawhide (Knight and McBride, 1989).

2.6.1 Climate chronology for KwaZulu-Natal 1830-1900

Climate chronologies were developed for the KwaZulu-Natal region during the 19th century by Nash *et al*. (2015) and Klein *et al*. (2016). These chronologies will support this research to differentiate between dry and wet phases in order to determine and relate climate impacts to such extremes. There were eight instances when the region was affected by severe and multi-year droughts, these included 1836 and 1900 (the austral summer rainy seasons of 1836-38, 1861-63, 1865-66, 1868-70, 1876-79, 1883-85, 1886-90 and 1895-1900 (see Nash *et al*.,2015). During the years 1896-97, relatively dry periods persisted and severe locust incursions and rinderpest were also highlighted, leading to food shortages and damaged crops (Nash *et al*., 2015).

According to Ballard (1983), the years 1878 and 1881 stood out as the worst years when drought was reported as bad, this affected the sugar and maize crops which were reduced to half the yield. The import of American maize was seen as a mechanism to address food security for the region during these years (Ballard, 1983). Despite the normal cyclical periods of droughts, difficulties, flooding and stock diseases taking place during the 19th century, KwaZulu-Natal and Zululand displayed favourable and probable climate conditions to allow agricultural development (Ballard, 1983).

Apart from the dry years, the region also experienced severe wet phases which were reported for the following years by Nash *et al*. (2015): 1847-49, 1854-57, 1863-65, 1879-81, 1890-91 and 1892-94. Heavy rains during wet periods were also responsible for causing considerable crop damages and washing away of top soils was also a notable effect which impacted on the Umgeni River (Nash *et al*., 2015).

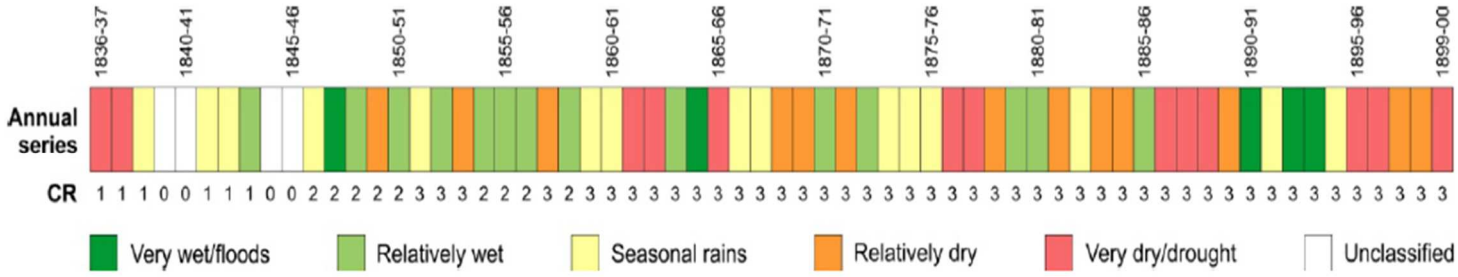


Figure 2-9: Climate Classifications for KwaZulu-Natal during 1836-1900(Source: Klein *et al*., 2016: 13).

2.6.2 The Zulu Kingdom

The Kingdom of the Zulus emerged during the early 19th century (Roaldset, 2010). Shaka ka Senzangakhona obtained chieftainship over the Zulu clans which encompassed 1500 people (Roaldset, 2010). However Klein *et al*. (2016) reported that prior to the late 18thcentury records from shipwrecked Portuguese noted a socio-political organization which became known as Zululand. The region formed small-scale chiefdoms which were defined by ritual practices and beliefs, acts of allegiance and cattle redistribution from chiefs to politically important groups (Klein *et al*., 2016).

2.6.2.1 Primary lifestyles

The lifestyles of the Zulus were formed around farming and breeding of livestock and majority of the people lived in largely sufficient homesteads (Roaldset, 2010). The importance of cattle to the Zulu people was more than a source of food; cattle were attributed to wealth of a village and were used for cultural purposes during ceremonies or during ancestral worships (Roaldset, 2010). Crop cultivation was the responsibility of Zulu women, while the men attended to cattle and homestead tasks (Knight and McBride, 1989). The chief diets of the Zulu consisted of curdled milk, sweet potato, maize and pumpkin (Knight and McBride, 1989). Maize was introduced in KwaZulu-Natal, only when permanent settlement was recognized as the crop was established for provisioning ships that were on the Indian trade route (Hall, 1976). In 1838, maize was introduced and grown in fairly small plots as autumn food, and although it had higher yields that sorghum, the crop demands wetter environments and is a less reliable source of food when there is poor rainfall (Hall, 1976). Significant changes in rainfall patterns had direct consequences for agricultural production and this became apparent when it is set against political changes in the 19th century Zululand and KwaZulu-Natal (Hall, 1976). Changes in social organization in Zululand are amongst the primary explanations for societal

transformation in the region in response to climatic extremes (Klein *et al*., 2016). Such changes noted were the confederation of Nguni chiefdoms, which clans such as Hlubi, Ngwane, Ndwandwe, Mthetwa, Qwabe and others emerged as dominating militaries (Klein *et al*., 2016). These clans were noted to rule large tracts of territory and numerous subordinate clans in the region (Klein *et al*., 2016). Such power struggles have led to Shaka and Zulu states eventually emerging as supreme.

2.6.3 Socio-economic context for KwaZulu-Natal

Between the period 1860 and 1895, the white farming communities expanded agricultural systems (Ballard, 1983). Manufacturing processes focused on the production of major export staples such as sugar, wool, wattle, tea, coffee and ostrich feathers (Ballard, 1983). During 1854 and 1866 the sugar industry in Natal experienced a high growth rate (Richardson, 1982). Non-profitable crops were articles such as maize and breadstuff. This was due to that fact that these articles did not have the ability to compete with the foreign market grains (in both import and export markets) (Ballard, 1983). During the mid to late 19th centuries, the black farmers in KwaZulu-Natal had positively adapted their pre-colonial subsistence staple crop such as maize and sorghum in order to meet the requirements of new demands of a capitalist's political economy (Ballard, 1983). The black peasant communities continued to grow food crops in order to meet their own dietary needs and subsistence requirements, whilst simultaneously producing surplus maize and sorghum for sale on the local markets (Ballard, 1983). This form of income enabled them to pay hut taxes, rent of their properties on white owned land, and purchase manufactured items (Ballard, 1983). Wealth was seen in cattle ownership amongst the black peasants who developed a cattle complex on which their social systems rested (Ballard, 1983). Locust appearances in 1895-96 were seen as a forerunner to a rinderpest outbreak which had indicated the weaknesses of the narrow base of black agriculture sector as compared to a politically stronger and more differentiated white farming sector (Ballard, 1983).

2.7 Summary

This section provides a context to the study regions that are applicable for this research. The information in this chapter provides a social, economic and environmental context for the regions and how past environmental changes have influenced livelihoods and enhanced adaptation. The information presented for all the regions also reflects on the previous work undertaken by Nash and Endfield, (2002); Kelso, (2010); Grab and Nash, (2010); Nash and Grab (2010);Nash *et al.,* (2015); Lupini, (2015); and Klein *et al*., (2016); who developed the climate chronologies for all these regions. In Namaqualand for example, droughts have

resulted in livelihood failure whilst also being responsible for affecting cattle and their ability to provide transport. Transhumance practices were often practiced in the Kalahari and Namaqualand and it formed part of the pastoral system. Regions such as the Karoo, Kalahari and Namaqualand were also reported to be highly prone to droughts as rainfall is highly variable in these regions. In Lesotho the impacts of climate variability is known to have affected vegetation. Whilst significant climate change in KwaZulu-Natal resulted in political changes, missionary influences were also seen as part of livelihood and economic changes for all the regions (Hall, 1976). Missionaries started introducing new types of crops which became highly favourable for the export markets. In addition missionaries also influenced economic and political formalities of people in Lesotho. Missionaries continued to introduce indigenous communities in the regions to European goods that were previously never introduced in the region (McKenna, 2011).

3 LITERATURE REVIEW



3.1 Introduction

The recent Paris agreement on climate change, embraced by 195 nations at the Conference of the Parties (COP) 21 at the United Nations Climate Change Conference (UNFCCC), extraordinary commitment by world leaders was signalled to address the social aspect of climate change (Pearson *et al*., 2016). Scientists and policymakers around the world are beginning to recognize that climate change is regarded as a social issue requiring social solutions and responses (Pearson *et al*., 2016; Mapfumo *et al.*, 2017). This is applicable within a societal context as predicted changes in temperature and weather patterns will have serious economic and social consequences (Arthurson and Baum, 2014).

A number of recent studies have shown the correlations of past climate change in relation to societal crises (see, Gerrard and Petley, 2013; Hannaford, 2014;Diaz and Trouet, 2014; Kelso and Vogel, 2015; Izdebski *et al*.,2015; Grau-Satorras *et al*., 2016; Cui *et al.,* 2017). Much attention has been given to the interaction between climate variability and human history during the last century (Diaz and Stahle, 2007). In the African context, climate variability has been linked to the transformation of society in pre-industrial eras (Hannaford and Nash, 2016).

Extreme climate events are expected to worsen and climate extremes will have notable impacts on societies (Hales *et al*., 2003). Impacts revealed have indicated trends of widespread disasters, famines, food security, physical infrastructure and disease outbreaks, triggered by droughts and flood events (Hales *et al*., 2003; Mayaya *et al*., 2014). In addition, climate factors have extensive influence on societies and economies, both past and present, with significant future implications (Carleton and Hsiang, 2016).

Historical records generate rich information, and predominantly in the context of disease, these records can provide a long-term series for investigating inter-annual associations between climate and diseases in society (Lafferty, 2009). In addition, historical records contain a wealth of evidence which indicates that past climate extremes have resulted in severe societal impacts (Diaz and Stahle, 2007). For example, records from 1878 reported deadly yellow fever epidemics which affected several cities in the United States, subsequent to an El Niño occurrence. Apart from the societal impacts of climate change mentioned above, climate change research is increasingly becoming fixated on the capacity of humans to respond to these impacts (Malone, 2009). Concepts such as resilience, adaptive capacity and vulnerability are forming theoretical contexts for studying and examining the social-environmental systems that exist, and responses that will be required to adapt to a changing climate (Malone, 2009). These concepts have also been widely used in the research undertaken by Kelso and Vogel (2015), which used a double exposure framework to highlight the context of contemporary vulnerability. This is applied in a historical context, which examines the cause of vulnerability and assesses adaptation methods (Kelso and Vogel, 2015). Hannaford and Nash (2016) further emphasized that the significance of historical climate-society research lies in the understanding of human vulnerability and resilience, in addition to understanding how past societies framed, responded and adapted to climatic change. Historical vulnerability is seen as an emerging field of global climate change research, and connects to environmental history and historical climatology (Kelso and Vogel, 2015).

3.2 Framing historical research relevant to societal impacts and consequences

A social science approach to understanding climate change relates to how this problem is represented in society and how people think and feel about it (Jaspal *et al.,* 2014). The societal impact of climate change on societal consequences initiated much debate over the last century by linking weather variables to economic outcomes, health, agriculture, crime and social conflicts (Papaioannou and de Haas, 2015). Climate variability and societal response have further been heightened because much interest has escalated concerns around the effects of anthropogenic climate change (Diaz and Trouet, 2014). The significance of historical climate-

society research is that it offers a bottom up approach seeking to irradiate human actions through exploration of vulnerability and extremes, and how societies framed, responded and adapted to climatic phenomena (Hannaford and Nash, 2016).

Past studies of social responses to climate change offer one method in which to draw understanding of the responses of socio-ecological systems to climate stress (Adamson, 2014). The benefits of historical studies allows for analysis of long-term effects of adaptation decisions upon social structures, and the analysis of adaptive decisions on overall climate variability to be made (Adamson, 2014). It is important to form an understanding of how human societies respond to environmental change in marginal locations, because in these marginal areas, societies have to maintain a careful balance with the environment in order to ensure survival and subsistence (Cui *et al.,* 2017).

3.3 Defining climate impacts

Climate impact, as identified in literature, refers to the effects that are caused by climatic variations or any anomalies which occur in the climate system (Norrgård, 2013). This includes disasters which are created through meteorological extremes or hazardous events such as severe rains, droughts, hurricanes, tornadoes and extreme floods (Norrgård, 2013). Climatic events and extreme weather are a major source of risk to societies (Stephenson 2008). Societal changes such as increased population trends and growth in infrastructure have made societies more vulnerable to such extreme events (Stephenson 2008). Extreme weather can also lead to loss of life and human livelihoods, particularly in vulnerable communities such as Africa (Otto *et al.*, 2015). Climate variability is determined by the frequency, the severity of impacts, the level of growth of these impacts and the spatial range of climate impacts (Pfister, 2007). Diaz and Stahle (2007) further point out that the severity of such impacts are also dependent on the intensity and duration of such climatic events and the socioeconomic surroundings at the time of such extreme climates.

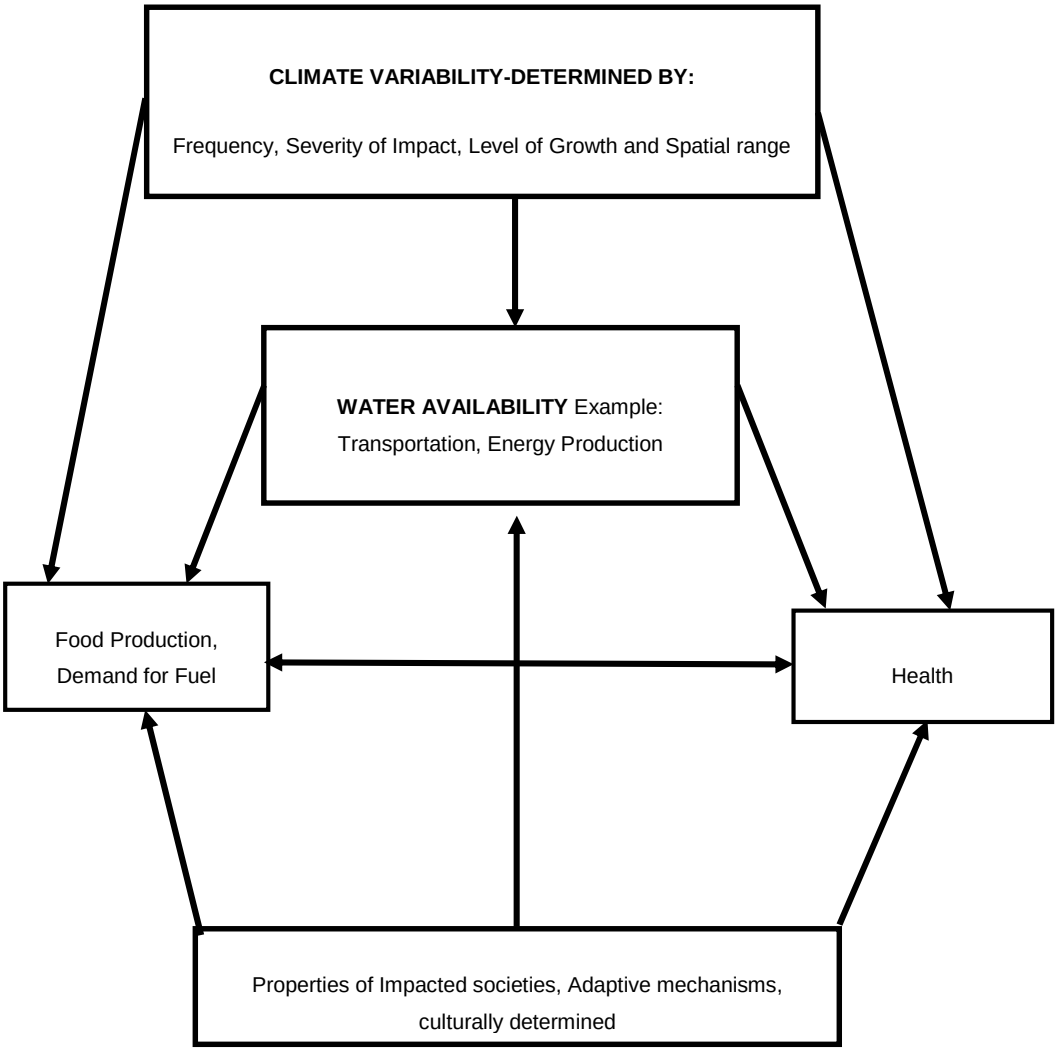


Figure 3-1: Climate Variability (Adapted from: Pfister, 2007)

Societal vulnerability towards climatic risks are dependent largely on factors such as society's cultural representation of the natural environment, technological levels, social systems, level of governance and the extent to which societies are prepared to withstand and form adaptive capacity towards climatic shocks (Pfister, 2007). In the context of agrarian societies, the issue was highlighted from analysis of food systems as shown in

Figure 3-1 of which food security was a major concern in these societies (Pfister, 2007). Similarly, food production and health are dependent on water availability; for example, climate will affect availability of water during a drought period (Blignaut *et al*., 2009). This will have an immediate effect on production of crops, food supply, health, and diseases which also depend on temperature thresholds in order to flourish (Pfister, 2007).

3.4 Classes of climatic impacts

The growth of research being undertaken on climate change has constantly focused on the capacity of societies to respond to associated climatic impacts (Malone, 2009). In line with this, concepts such as coping, adaptive capacity, and resilience provide a conceptual framework that will allow for examination of socio-environmental systems that exist and will require change in order to respond to a changing climate (Malone, 2009).

The IPCC (2012) further identifies three categories of impacts which include:

- Changes to the physical environment, such as storm events causing erosion,
- Ecosystem changes caused by hurricanes or strong wind force, and
- Adverse effects on humans and societal situations/assets/environments.

Not all climatic impacts have negative effects. For example, the IPCC (2012) states that flood-inducing rains may have a positive bearing on crops while a period of intense freezing (cold spell) may reduce pests and other insects which would normally have an impact on harvests. Widgren (2012) argues that previous research undertaken on the role of climate on societal change has not clearly defined and distinguished between gradual long-term change in climate versus weather events such as drought or flooding. This requires conceptual clarity when focusing on climate change and its possible relationship with more frequent extreme weather events. Often the concepts such as climate events or extreme weather are mentioned without adequately defining its context (Widgren, 2012). Given that this research focuses on the influence of climate on societies, these distinctions need to be precise. Society is particularly vulnerable to severe weather events and these events can result in impacts known to cause damage to infrastructure, injury and possible death. In addition, impacts felt may be different in terms of their consequences; for example, severe weather which may result in injury or even deaths. Thus, extreme weather impacts are a major source of risk for all societies and should be defined as such (Stephenson, 2008).

3.5 Extreme impacts

An extreme impact encompasses highly significant consequences which are long lasting to society, the natural and physical environment and its ecosystems (IPCC, 2012). Extreme impacts can be followed by a single extreme event, a successive extreme or non-extreme event. Such impacts include non-climatic events such as fires, which are followed by heavy rains which may lead to erosion or a landslide (IPCC, 2012). Extreme events are also defined as being rare events. Easterling *et al.* (1999) indicated that extreme events can be unpacked in various ways such as extreme daily temperatures, extreme daily rainfall quantities, and areas which experience unusual warm monthly temperatures or storm events such as

hurricanes. Extreme impacts are determined by the degree of exposure that an extreme event is likely to impose on humans or social systems (Easterling *et al.*1999*;* IPCC, 2012). This also relates to the magnitude of the event. A disaster signifies an extreme impact suffered by society, through loss of life, economic losses or both (IPCC, 2012). An event is classified as severe when there are associations with great losses such as human lives, economic damage in terms of capital and reduction in environmental quality (Stephenson, 2008). Severe events result in large losses such as number of lives, financial capital or environmental quality, such as species loss (Stephenson, 2008). The severity of impacts can also be measured by the expected losses that will occur in the long term, which is known as risks (Stephenson, 2008).

The term extreme weather is a rather broad concept and can be unpacked from multiple disciplinary perspectives (Morss *et al*., 2011). It may be defined by some from a climatological perspective, which includes weather conditions that exceed a certain threshold, such as for example freezing temperatures. Defining it from a societal perspective describes it as hazardous weather related events that result in significant damage or disastrous consequences, such as heat waves or high impact storm events (Morss *et al*., 2011). Lynch *et al*. (2008) further defined weather extremes as hot days and nights (including heat waves), cold nights and days (including frosts), heavy rainfall events, droughts, floods, hail and thunderstorms, extreme winds, fires and tropical cyclones.

Hov *et al*. (2013) define catastrophe classes which are determined by the monetary or humanitarian impact it may have, which is further dependent on whether it is a natural occurrence with small economic or social impact or a great natural catastrophe. Six classes of loss events have been described and range from 0 (being the least impact) to 6 (being the highest impact with severe losses) (Table 3-1).

Table 3-1: Catastrophe Classes (Hov *et al.*, 2013)

Catastrophe Classes		Profile of Damage/loss
0	Natural Event	
1	Small-scale loss event	No property damage
2	Moderate losses	Small scale property damage
3	Severe catastrophe	Severe property infrastructure and structural damage
4	Major catastrophe	Major property, infrastructure and structural damage
5	Devastating catastrophe	Devastating losses within affected regions
6	Great natural catastrophe-equates to a great disaster	Fatalities may be thousands or even hundreds, substantial economic losses, people homeless/displaced.

Documented events are arranged into catastrophe classes which are defined by their natural occurrences (Hov *et al*., 2013). Classes are ranged according to their impact levels, such as for example great catastrophes could mean that the impacts overreach the affected region's

ability to help itself, similarly, such classes define impacts which may even result in death, or people being displaced (Hov *et al*., 2013). Such catastrophe classes can be used in long-term climatic analyses.

3.6 Recent climate changes

The African continent has contributed the least towards greenhouse gas emissions, yet is one of the most susceptible and vulnerable continents to the impacts of climate change (Hoffman and Vogel, 2008). This is attributed to many factors such as high dependency on natural resources, agriculture and livestock for livelihood sustenance (Hoffman and Vogel, 2008, Bryan *et al*., 2009). Extreme poverty and low adaptive capacity arising from high poverty levels, complex governance systems, financial strain, ecosystem degradation, and complex disasters coupled with conflict (Tirado *et al.,* 2015), also affects the ability of people to respond efficiently towards increased drought and flood occurrences. In addition, high population growth rates in subtropical regions on the continent are known to be affected by temperature increases and reduced precipitation (Hoffman and Vogel, 2008).

3.6.1 Climate impacts

The global climate is constantly changing and will continue to change in the forthcoming centuries at extraordinary rates (Adger *et al*., 2003a). A history of climate change should therefore draw on some of the extreme events and highlight changes in frequency of such weather events (Pfister, 2010). Societal vulnerability towards the risks may worsen ongoing social and economic challenges, mainly for those societies that are dependent on resources which may be sensitive to these climate extremes (Adger *et al*., 2003a). Historical information emphasizes that abrupt climatic changes have affected food yields, nutrition, survival, epidemic outbreaks, unrest and social conflict which has resulted in deaths, injuries and disease outbreaks (McMichael, 2012; Kreslake *et al*., 2016).

The El Niño of 1982 and 1983 for example, was noted as the strongest for the twentieth century, causing droughts, floods, famine, disease and massive economic impacts in many parts of the world (Agrawala *et al*., 2001). Societies that have responded to such ENSO events in recent decades are relatively modernized and, in many places, less 'indigenous' in nature than they would have been during the 19th century (Agrawala *et al*., 2001). Environmental and societal contexts were thus very different during the 19th century and so it is of interest to explore the impacts and responses related to climate events in the past. The section below highlights the relationship between climate and health, and provides examples of health impacts which have occurred during the 19th century in various regions. This ranges from:

health impacts; livestock diseases; agriculture; vermin in crops; economic losses and infrastructure damages.

3.6.2 Droughts

According to Twomlow *et al*. (2006), drought is a recurrent feature of a regions' climate. Drought is a natural hazard having significant environmental, economic and societal consequences (Folger *et al*., 2013; Masih *et al*., 2014).Droughts can also be enhanced by meteorological factors such as air temperature, humidity and wind speed (Brázdil*et al*., 2018).Such examples of how it affects societies include: crop failures, shortage of food leading to famine in many areas, malnutrition, starvation, health issues and mass migration of people (Masih *et al*., 2014). Nash (2017) further argued that rainfall variability is one of the most cited drivers of food insecurity particularly because there is a decline in staple food prices towards the end of austral summers due to increased availability following local harvests.

People define drought in many different ways; for example, a farmer may measure it according to a lack of crops, pastures and agricultural harvests, while a meteorologist may describe it as a lack of rainfall, while others would define it in religious terms, stating that it was an act of God (Beattie, 2004). Historical analysis of droughts made use of tree ring records and instrumental data to determine the severity of such drought events (Herweijer *et al*., 2006). Three multiyear droughts occurred during the latter half of the 19th century in the USA during the periods 1856-1865, 1870-1877 and 1890-1896 (Herweijer *et al*., 2006; Folger and Cody, 2015). The impacts thereof were on farming communities. Gallo and Wood (2015) have cited prolonged periods of winter droughts in the Great Plains during 1777-1869. The history of droughts in Brazil has resulted in social tragedies such as public health problems (Alpino *et al*., 2016). The drought that occurred in Brazil during 1877-1879 resulted in deaths of approximately 500,000 people which were in part also due to a smallpox epidemic (Alpino *et al*., 2016). Other impacts included displacement of three million people who were made refugees.

Nash (2017) indicated that the principal narrative for southern Africa highlighted that climate was progressively becoming drier. During the late 19th and early 20th centuries, such narratives shifted towards the identifying cyclical rainfall disparities (Nash, 2017). The episodes of drought affected large portions of the summer rainfall zones (SRZ) during the early 1800s, late 1820s, late 1850s-mid 1860s, late 1870s, early to mid-1880s and the mid to late1890s (Nash, 2017). The most severe drought was reported during the 1860s, with the most extended drought periods reported for the early 1820s and 1890s, corresponding to the more extreme ENSO warm phases (Nash, 2017).

3.7 The link between climate and health impacts

The following illustration adapted from Hales *et al*. (2003) serves to highlight the impact of weather extremes such as floods and droughts on human health. The information presented (Table 3-2), specifically highlights the impacts of flood/wet spells and its relation to human health. A flood event may result in major diseases such as malaria that can hamper social development. Similarly, a drought period (Table 3-3) can have severe impacts on health resulting in changes in water availability, reduction in food supplies and reduced water quality, which can all impact on human health (United Nations Economic Commission for Africa, 2011).

Table 3-2: The Impact of Flood Events on Health (Adapted from Hales *et al*., 2003)

Climatic Event	Characteristic	Description	Health Impact
Heavy Precipitation	Meteorological	"extreme weather event"	Increased or decreased mosquito
Flood	Hydrological	River /Stream overflow its banks	Increase in mosquitoes and surface water contamination
Flood	Societal	Property/Crop Damages	Water Contamination/changes in mosquito abundance
Flood	Disaster/Catastrophic flood	Flood leading to >10 and/or 200 affected	Diseases, deaths, human drowning, injuries, health effects and loss of food supplies.

Table 3-3: The Impact of Drought Spells on Health (Adapted from Hales *et al*., 2003)

Climatic Event	Characteristic	Description	Health Impact
Drought	Meteorological	Decrease in soil moisture content. Increase evaporation	Change in abundance of vector, drier conditions allow for breeding of vector borne diseases.
Drought	Agricultural	Dry conditions impacts on crop production	Dependent on socioeconomic factors such as alternate availability of food sources and means to acquire it.
Drought	Societal	Reduction in supply of food, income, water supply and reduced water quality	Food Shortages, hunger and malnutrition. Increase chance of risks and diseases which are associated with deficiency of hygiene.
Drought	Food Shortages/Famine/Droughts	>10 people killed and/or 200 people affected.	Deaths in terms of starvation and lack of nutrition. Further health impacts may be related to population displacement/ spread of diseases.

Changes in health patterns, disease and population survival have over time, shown an interaction between human biology and environmental conditions (McMichael, 2002). Human

health is seen as an indicator of how well the environment is managed, with human health playing a key role in sustainable development. For instance, typhoid fever outbreak is a relatively threatening disease worldwide, causing numerous deaths, particularly in poor, developing regions such as the Indian sub-continent (Dewan, *et al.,* 2013). Warm, humid conditions will create habitats for insect and vector-borne diseases, which contributes to vector breeding and reproduction leading to malaria (Kreslake *et al.*, 2016).

The projected health impacts of climate change are mainly negative, with the most severe impacts occurring in low-income countries, where adaptive capacity is low (Confalonieri *et al*., 2007). The projected temperature increases and rainfall patterns can result in an increase in malnutrition, diseases and injuries due to heatwaves, heat stress, floods, storms, fires, droughts, diarrheal illness, and the frequency of cardio-respiratory diseases due to air quality issues (Serdeczny *et al*., 2016). There are some benefits to health, to be expected, including fewer deaths due to exposure to the cold, and reductions in climate suitability for vector-borne diseases in some regions. Table 3-4 summarizes the comparative direction and scale of projected health impacts which consider the number of people at risk and their ability or potential of adaptive capacity (Confalonieri *et al*., 2007).

Table 3-4: Relative Direction and Scale of Health Impacts

(Adapted from Confalonieri *et al.,* 2007)	**Negative Impact**	**Positive Impact**
Very High Confidence	←	→
Malaria: Reduction and Expansion	←	
Transmission season changes		
High Confidence		
Increase in Malnutrition/Hunger	←	
Increase in the number of human deaths, disease and injuries from extreme weather events		
Increase in cardio-respiratory diseases due to air quality changes	←	
Change/Increase in range of infectious disease	←	→
Decrease in cold-related deaths		→
Medium Confidence	←	
Increase in diarrheal diseases/dysentery		

Research undertaken by Lafferty (2009) pointed out that the recent spread and rise in infectious diseases may not just be attributed to climate change. There are several additional factors which may contribute to this problem, which include the destruction and alteration of habitats, migration patterns, alien invasion, urban heat islands, population density, health services and wealth distribution (Lafferty, 2009). Various examples in this section have highlighted that climate change already contributes to the global burden of disease, resulting in deaths (Confalonieri *et al*., 2007; Dewan *et al*., 2013). Climate change plays an important part in the spatial, seasonal and temporal distribution of diseases such as malaria, dengue fever, and cholera, which fluctuate with factors such as longer rainy seasons, high temperatures, and inadequate water drainage (Confalonieri *et al*., 2007; Gemeda and Sima, 2015; Bickton, 2016).

3.7.1 Climate induced health epidemics during the 19th century

Interest in the role of weather and climate on health of pre-industrial societies has sparked much attention (Rocklöv *et al*., 2014). It was reported by McMichael (2012), that climatic changes have affected human health and survival over a long time in history. Evidence of climate impacts from written records up to 5 millennia ago provided an indication that climate changes resulted in food shortages, famine, starvation and even deaths (McMichael, 2012). In addition, temperature extremes have known impacts on human health such as increase in heat related stress and diseases. Such temperature extremes have been reported to have caused human health impacts in the United States. For example, the hot summers experienced in the United States during 1952-1955 each caused more than 500 deaths, with > 5000 heat related deaths estimated in 1963 and 6700 during 1966 (Kunkel *et al*., 1999). Åström *et al*. (2016) highlighted that between 1800 and 1859, temperature and precipitation impacted greatly on human mortality while lower temperatures increased infectious diseases and cardiovascular diseases. This was due to lower summer temperature affecting poor harvests and leading to decreased nutritional intake and resource scarcities (Åström*et al*., 2016).

During the 1870s and 1890s, extreme droughts and warmer temperatures occurred in the following regions: China, South Asia, Australia and Brazil (McMichael, 2012). These droughts were associated with strong El Niño events which resulted in desiccation throughout regions of Africa, Asia and South America, causing an estimated 30-50 million deaths in countries like India, China and Brazil (McMichael, 2012). Famines that were reported during 1876-1878 have also resulted from the combination of droughts driven and exacerbated by El Niño events (McMichael, 2002). In addition, colonial forced integration of local food markets with the global emerging markets compelled countries like India to export wheat (McMichael, 2012).

Devastating famines which took place between 1878 and 1879 after prolonged droughts have resulted in 10 million deaths from starvation and disease outbreaks in North China (McMichael, 2012). During 1877 and 1878, Brazil experienced severe droughts which resulted in death from starvation and an outbreak of smallpox (McMichael, 2012).

It was reported by Roque (2013) that the climate of Mozambique in 1896 was unfavourable to health. Various diseases mentioned were related to malarial fevers, often articulated as being severe, with mention of hematuric bilious fevers, affecting liver function (Roque, 2013). The climate during this period was highlighted as being the primary cause of all diseases and illness, however Roque (2013), emphasised that a lack of sanitation, hygiene, improper sewage, and an accumulation of garbage were also some of the factors which exacerbated diseases and health conditions. Similarly, Coovadia *et al*. (2009) reported that during the late 19th and 20th centuries, inadequate sanitation, overcrowding and malnutrition caused much impact and stress toward the health of black populations in South Africa.

3.7.1.1 Typhoid fever

Typhoid fever, a water-borne disease, is described as an acute infectious fever which is caused by Salmonella Typhi and is characterised clinically by cases which include long continued pyrexia, headaches, moderate enlargement of the spleen, and abdominal tenderness (Hadisaputro, 1998). One of the leading causes of mortality across the world is attributed to typhoid fever (Dewan *et al.,* 2013). Globally, it has been reported that there are 22 million new cases of typhoid fever every year that have been reported with 200 000 of these cases resulting in death (Dewan *et al.,* 2013, National Institute for Communicable Disease, 2016). The highest number of cases are said to have occurred in south central and south eastern Asia and is rampant in areas which are impoverished and have inadequate sanitation and unsafe drinking water standards (Abdulkarim, 2012; Dewan *et al.,* 2013). Typhoid is conveyed by the faecal-oral route through contaminated food and water and is therefore common where sanitary conditions are insufficient and access to clean water is inadequate (Parry, 2005). Other risks for typhoid outbreaks include close contact with typhoid cases, closer location to water, flooding, poor lifestyle, hygiene and sanitation (Dewan *et al.,* 2013; Akullian *et al*., 2015).

Climatic variables such as rainfall, vapour pressure, and temperature contribute to and exacerbate the spread and dissemination of typhoid infections (Akullian *et al*., 2015). Two extreme weather conditions, namely flooding and drought, increase the risk for the transmission of typhoid (Latimer, 2018). During dry periods, water sources are more likely to be contaminated with microbes such as typhoid, while during flooding, water resources are

likely to be contaminated with faecal matter resulting from poor sanitation and sewage (Latimer, 2018). Floods and droughts therefore create high risk environments for the transmission of typhoid. In addition, other environmental factors such as open sewers, highly contaminated water bodies and rainy seasons pose a high risk for typhoid fever outbreaks (Akullian *et al*., 2015). Amongst these factors are also socio-economic factors such as population density, overcrowding and poverty which affects the spread and the chain of infection of typhoid (Hadisaputro, 1998) Typhoid fever was common in the United States and Europe in the 19th century, however despite this; it is now experienced mostly throughout the developing world (Parry, 2005). In the last fifteen years, resistance to antibiotics used for treating the disease has resulted in large epidemics and in difficulty in managing the disease (Parry, 2005).

In the city of Toronto, typhoid fever peaked during the 1870s (Barkin and Gentles, 1990). During this period, the city lacked proper water treatment systems which also contributed towards the burden of the disease and posed serious health hazards. It was further reported by Barkin and Gentles (1990) that during the 1860s Toronto was thought to be of one the dirtiest and unhealthiest cities due its negligent attitude towards water supply, and thereby fuelling a steady increase in mortality from typhoid and other related diseases. The number of typhoid deaths peaked in Toronto during the 1870s (see Table 3-5). The low cases of typhoid during the 1850s were due to the establishment of improved public waterworks. However typhoid peaked during 1893 when conduit pipes were broken, resulting in disposed waste being deposited onto the ice during the winter months. The result of such incidents spiked up the cases of typhoid during 1890, 1891 and the late winter of 1893 (Barkin and Gentles, 1990).

Table 3-5: Typhoid Mortality in Toronto during 1850-1899 (Barkin and Gentles, 1990)

	1850-54	**1855-59**	**1860-64**	**1865-70**	**1870-74**	**1875-79**
Male	0	2	6	13	59	29
Female	0	5	5	8	35	29
Total	0	7	11	21	94	58
	1880-84	**1885-90**	**1890-94**	**1895-1899**		
Male	24	14	32	15		
Female	24	14	29	11		
Total	48	28	61	26		

Cases of typhoid outbreaks in southern Africa were related to the concentration of camps during the South African war (Scott, 2007; van Heyningen, 2010). Such outbreaks of diseases

have been an important influence on the health of southern Africans (Coovadia *et al*., 2009). It has also lead to the impoverishment of black populations in the face of white affluence (Coovadia *et al*., 2009). Camps were often deficient of supplies, and basic necessities (van Heyningen, 2010). Poorly managed camps resulted in typhoid epidemics killing 8020 British soldiers, whilst infecting many water courses in the country (van Heyningen, 2010). British war troops carried typhoid diseases with them as they progressed through war, and polluted the local water supplies (van Heyningen, 2010). One of the most common ways of contracting typhoid during the South African war was drinking of water from polluted streams (Shearing, 2004).Typhoid was identified in 1890 in South Africa, and an effective vaccine was created by Dr Almroth Wright in 1897; however the vaccine was used infrequently during the South African war (van Heyningen, 2010). Amongst typhoid outbreaks, measles was also prevalent at the start of the war; however, conditions during wartime influenced the rapid spread of the disease due to overcrowded living conditions in the camps (van Heyningen, 2010).

3.7.1.2 Smallpox

The smallpox disease appeared to have been confined to Eurasia and a few adjacent countries such as Japan, Ceylon, Philippines and parts of western Africa up to the 15th century (Fenner *et al*., 1988). During this period, the majority of central and southern Africa was free of the disease, but this changed with the great explorations of Europeans to America, Africa and Australia between the 15th-18th centuries (Fenner *et al*., 1988). Fenner *et al.* (1988) indicated that smallpox first arrived in South Africa during the 18th century (1713 and 1755) and spread into central Africa with the slave traders (Figure 3-2).

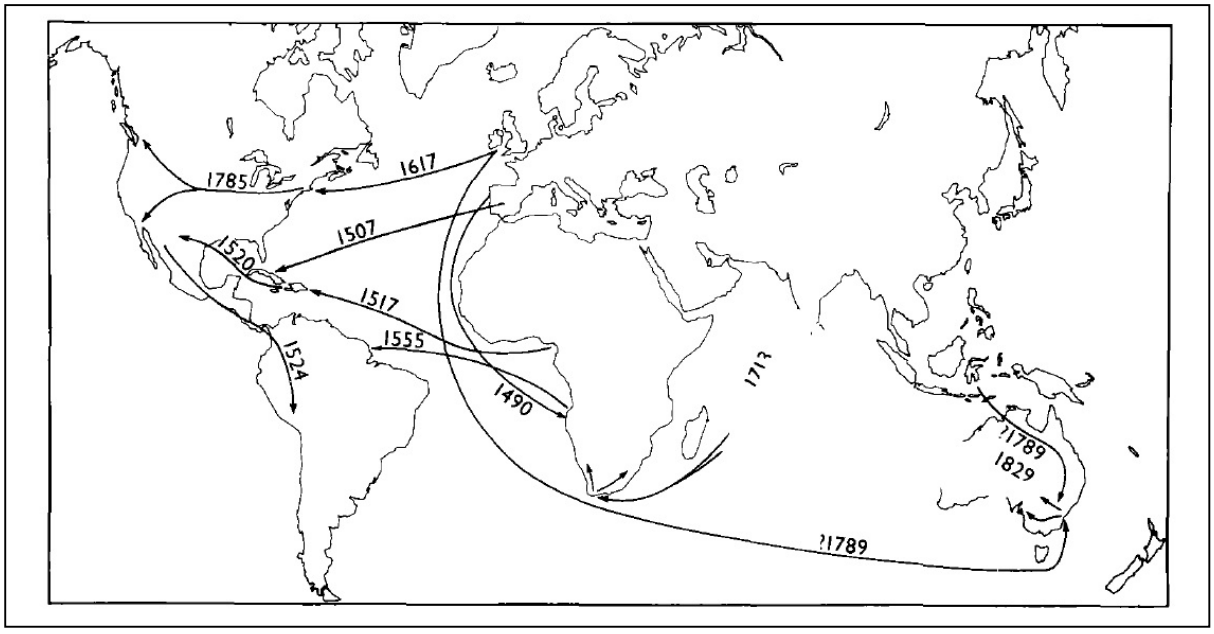


Figure 3-2 : The spread of smallpox through European Colonization and Exploration to America, South Africa and Australia(Source: Fenner *et al*., 1988: 232)

In 1713 the smallpox disease reached South Africa with a ship returning from India that docked at Cape Town (Fenner *et al*., 1988). Although smallpox did not become an epidemic, the disease entered the Cape as a result of imports from Ceylon during 1755. However smallpox outbreaks were also reported to have been associated with the Atlantic slave trade which brought Arab slaves into east Africa, carrying smallpox from Mozambique into Cape Town in 1812 (Fenner *et al*., 1988). The Atlantic slave trade presented exceptional conditions for the spread of small pox, since raiders entered deep into the interior of the African continent which carried the disease far and wide in areas such as central Africa (Fenner *et al*., 1988). Smallpox thrived on dense human populations in order to sustain its cyclic recurrence in the form of an epidemic, however the disease also spread along with trade, pilgrimage and invasion routes into new regions (Arnold, 2008). The disease stretched as far as the Kalahari and was widespread amongst the Hottentots and Bushmen. Nishiura and Kashiwagi (2008) have established that the transmission of smallpox is seasonal and mostly associated with dry weather. During periods of short–term epidemics, the spread of smallpox was reported to be enhanced by dry weather (Nishiura and Kashiwagi, 2008).

3.8 Livestock diseases

Animal and livestock production forms a major component of food security through the provision of milk and eggs. Worldwide, domestic animals serve as a means of subsistence for hundreds of millions of families who are in poverty and depend on livestock and animals for food, subsistence and transportation (Oyhantçabal *et al.,* 2010). Climate change has an influence on livestock production by affecting the conditions that are essential for animal production, fodder crop production and animal health (Oyhantçabal *et al*., 2010). The impacts of climate change on the health of animals have been given much attention and this section covers such impacts that were also relevant to the 19th century.

The direct effects of climate change on animal health include temperature related illness causing death, and sickness of animals during extreme events (Nardone *et al*., 2010). Some of the indirect impacts include distribution of vector borne diseases which are dependent on environmental and climatic conditions, food and water scarcities, and food borne diseases (Forman *et al*., 2008; Nardone *et al*., 2010). Temperature has a direct impact on development and transmission of vector borne diseases (Bett *et al*.,2016). Abdela and Jilo (2016) highlighted that most diseases are transferred by vectors such as ticks and flies, the growth stages of which, are highly reliant on temperature.

Climate also affects animal diseases through changes in rainfall and temperature which may further exacerbate the distribution and abundance of disease vectors (Abdela and Jilo, 2016).

Examples of vector borne diseases affecting livestock during the 19th century includes Rift Valley Fever, African Horse sickness and bluetongue, which are influenced by, and vary with seasonal and longer-term climatic changes (Abdela and Jilo, 2016). It was observed in Lesotho where a severe drought during 1862 caused impacts to pastures resulting in many deaths of oxen, goats, cows and horses (Nash and Grab, 2010). Many cattle suffered from famine due to the lack of food (Nash and Grab, 2010).

Some diseases such as African Horse Sickness (AHS), rinderpest, contagious bovine pleuropneumonia (CBPP) and bluetongue were common diseases mentioned during the 19thcentury. Although not all of these diseases may be caused by climate change, they may become exacerbated by climatic variability. In this following section, an attempt has been made to summarize some aspects of such diseases related to its history, economic importance, the disease epidemiology and distribution, and where possible, draws on the link between climate change and such outbreaks.

3.8.1.1 Bluetongue

Bluetongue is an endemic disease to sub-Saharan Africa and has resulted in substantial economic losses for those who use and depend on sheep breeds, particularly in southern Africa (Lancelot *et al.,* 2008). Bluetongue is an infectious and non-contagious disease occurring mainly in sheep, goat, camels, cattle, deer and antelopes, however primarily effects sheep and deer (Amin *et al*., 2016). The bluetongue disease was first defined in the Cape Colony of southern Africa after merino sheep were introduced into the region in the late 18thcentury, when sheep farming began in South Africa (Maclachlan, 2011; Maclachlan *et al*., 2015; Amin *et al*., 2016). The disease was later recognized in other parts of Africa, Europe, the Middle East and Indian subcontinent, the Americas, and Asia (Maclachlan, 2010). This disease, which affects sheep, was reported as being prevalent during the summer months, and is exacerbated during wet seasons (Maclachlan, 2011).Climate and environmental changes are likely to exacerbate the transmission patterns of the bluetongue disease, and cause disruptions to the local epidemiological equilibrium (Lancelot *et al.,* 2008). Some of the symptoms of infected sheep showed signs of soreness of the mouth and feet, which was similar to that of foot and mouth disease (Maclachlan, 2011). The work of Ballard (1983) indicated that bluetongue in KwaZulu-Natal appeared during the 1860s and 1870s and placed a huge impact on many sheep, and thereby, on farmers who endured economic repercussions of the diseases during that period.

Recent research by Baylis (2017) reveals a strong link between the outbreaks of bluetongue and recent climate changes. Climate variability increases the risk of the transmission of the

bluetongue virus (Baylis *et al*., 2017). Changing climate has also increased the conditions for the virus to thrive, and in certain environments increased the ability of native vectors to transmit the virus (Baylis *et al*., 2017). Climate models also reveal that as the climate continues to warm, it will continue to increase future risk of bluetongue outbreaks (Baylis *et al*., 2017).

3.8.1.2 African Horse Sickness

African horse sickness (AHS) is a viral disease which is fatal in horses and mules (Scacchia *et al*., 2009). The disease is characterized by pathological disorders causing respiratory and cardiovascular impairment (Scacchia *et al*., 2009). The virus originated in Africa, and became recognized due to the introduction of horses during the exploration of central and east African regions (Mellor and Hamblin, 2004). African horse sickness was reported in 1569 in East Africa, affecting horses which were imported from India (Maclachlan, 2010). Horses and donkeys were not indigenous to southern Africa, and were introduced after the arrival of the Dutch East India Company (DEIC) in the Cape of Good Hope during 1652 (Maclachlan, 2010; Carpenter *et al*., 2017). The sickness, in historic times has been prevalent across the whole of South Africa and the outbreak of horse sickness was recorded throughout the 19thcentury (Mellor and Hamblin, 2004). In the southern African region, the AHS virus was recognized until some 60 years after the introduction of horses in 1657 (Mellor and Hamblin, 2004). The first major outbreak of AHS was in 1719, killing 1700 horses (Mellor and Hamblin, 2004). The largest outbreak of AHS was recorded in southern Africa during 1854-1855, killing over 70 000 horses (Mellor and Hamblin, 2004).

In South Africa, there is a strong correlation between AHS epidemics and the timing with El Niño phase of ENSO (Mellor and Hamblin, 2004). In addition, ENSO brings about a combination of heavy rains and drought in South Africa and the vector of AHS breeds in wet soils (Mellor and Hamblin, 2004). It has also been noted that 13 out of 14 major epidemics in South Africa related to AHS, have coincided with the warm phase of ENSO, however, Mellor and Hamblin (2004) emphasized that since 1803, there were 42 ENSO events which have occurred, and there were no correlations with the occurrence of AHS. This is further unpacked by indicating that in South Africa, the warm phase of ENSO may result in heavy rain which subsequently follows a drought, and no records of AHS occurred during these years (Mellor and Hamblin, 2004).

3.8.1.3 Rinderpest

Rinderpest, also known as cattle plague was a disease which occurred in ancient times in Europe and Asia (Roeder and Rich, 2009; Youde, 2013). Rinderpest is contagious and is characterized by necrosis and erosions throughout the digestive tract (Roeder and Rich,

2009). Initial outbreaks of rinderpest occurred in the early 20th century from Asia and spread into Australia and South America a few years later (Roeder and Rich, 2009). Compared to eastern Africa, rinderpest appeared toward the end of the 19th century when it spread rapidly throughout the African continent (Roeder and Rich, 2009). In African society, cattle were significant and imperative for their social, economic and religious uses, and importantly it was portrayed as a symbol of wealth (Mwatwara and Swart, 2015). The uses of cattle were mainly for labola (bride-wealth) negotiations, ploughing and transport and supply of milk and manure (Mwatwara and Swart, 2015). Diseases such as rinderpest were therefore very devastating to cattle, causing much impact to livelihood and economic losses.

The breakout of rinderpest first occurred on the African continent in 1841 when domestic cattle were infected in Egypt by cattle imported from Romania, resulting in the death of 75% of cattle (Tambi *et al*., 1999). In southern Africa, during the 19th century, rinderpest annihilated large numbers of cattle (Molosiwa, 2014). In the south of the Sahara rinderpest first made its appearance in Ethiopia in 1884, through import of cattle from India. Major outbreaks were reported throughout the province of Hamasien from where the disease then spread (Tambi *et al*., 1999). During 1888 and 1889, rinderpest spread southwards throughout all of Ethiopia as well as neighbouring Somaliland, Kenya, Uganda and Sudan. By late 1892, 90% of the cattle in Ethiopia were lost, while Uganda lost an estimated 95% of the total population of 400 000 cattle (Tambi *et al*., 1999).

The turn of the 19th century indicated that rinderpest had spread from East Africa to southern Africa (Njeumi *et al*., 2012). Rinderpest spread for the first time in sub Saharan Africa between 1888 and 1897 resulting in the demise of 90% of African cattle (Sunseri, 2016). The Zambezi River basin served as a barricade which rinderpest encountered in its travels southwards, however in 1896 the disease appeared in Southern Rhodesia (van Onselen, 1972). The disease was moving quite rapidly and made its way into Northern Rhodesia, spreading into Bechuanaland in March of 1896 (van Onselen, 1972).

At this time, the government of the Cape Colony, Natal and Transvaal requested assistance from several European scientists in finding methods to control the disease (van Onselen, 1972). By the time rinderpest appeared in southern Africa, in the 1890s, some control methods started to become established in the region (van Onselen, 1972). Rinderpest led to differentiation and uneven distribution of resources that were accessible (Mvenene, 2014). It also led to the decline of peasant dependence on cattle herding and farming in favour of the capitalist economy (Mvenene, 2014). Rinderpest weakened the social, economic and cultural integrity of local peasants because they were then forced to barter cattle that survived rinderpest for grains with white traders (Mvenene, 2014).

The disease was prevalent in times of drought, a distressed period in which cattle were already weakened by drought induced famines, thereby making them more susceptible to the disease. Inadequate rainfall compromised the quality of pastures and affected all sources of water, which had a distressing impact on cattle (Molosiwa, 2014). Such dry/drought years recorded for the regions made cattle more susceptible to infectious diseases such as rinderpest which increased their vulnerability to the disease. In times of drought, the disease was also facilitated in transmission by bringing animals close together at watering points or sources of pasture (Sunseri, 2016). Animals such as jackal, hyena and vultures and common game such as springbok, kudu and wildebeest made contact with domestic cattle and the disease was then transmitted and spread across species (Marquardt, 2009). The transmission of rinderpest occurred in two ways either through animals coming into close contact through mingling or through faecal transmission (Marquardt, 2009). The spread of the disease would occur along roads, pathways and open plains (Marquardt, 2009).

The need for such essential resources such as access to water, food and major trade routes were an increasing problem for the control of rinderpest (Marquardt, 2009). Water remained an important natural resource for the survival of cattle and wild animal populations (Marquardt, 2009). Roads and pathways used for travel helped to distribute the rinderpest disease, however water also formed the basis for the spread of rinderpest, especially isolated water bodies (Marquardt, 2009). Domestic and wilds animals often visited these water bodies and this created a suitable environment for the spread of rinderpest (Marquardt, 2009). The advancement of rinderpest through sub-Saharan Africa between 1888 and 1897 indicated on-going contact between livestock and wildlife ecosystems (Sunseri, 2016). The conditions that were suitable for the spread of the rinderpest virus were sunlight, temperatures and humidity (Sunseri, 2016).

According to Ballard (1983), rinderpest was defined as a contagious viral disease which was characterized by diarrhoea, nausea and lacrimal discharge which also caused ulcers around the mucous membrane of the mouth. During early 1896, rinderpest broke out among trek oxen along the Harrismith town-lands on the Natal-Free State border (Ballard, 1983). At this time, the Natal government was pressured to prevent the disease from entering the colony via infected livestock hides, clothing and people passing from the Orange Free State, the South African republic and Zululand (Ballard, 1983). In response to the disease outbreak, the Natal government formulated a plan of action which contained the construction of a fence from the extreme northern point of the colony alongside the north-eastern boundary towards the mouth of the Tugela River. The plan called “General Plan for Meeting the Dangers of rinderpest” included the following requirements as quoted from Ballard (1983):

"*A fence is the course of erection from the extreme northern point of the colony along the north-eastern boundary towards the mouth of the Tugela*. *An inner fence will be restricted as soon as possible so as to establish a neutral zone between the two fences*" (Ballard, 1983:5).

"*Each border will be closed against all traffic the moment that this extreme step is warranted by the spread of the disease in the neighbouring territory*" (Ballard, 1983:5).

Protection measures such as fencing off farms and land were also a mitigation measure reported for controlling rinderpest in KwaZulu-Natal.

"*The best protection against the spread of the disease is the immediate repair of all existing fences, and the fencing of all farms not already fenced, and the making of inside paddocks. The Government will consider all applications for loans to be used in erecting fences as a protection against Rinderpest*" (Ballard, 1983:5).

Further response measures undertaken during the 1890s included the application of regulations derived from the Cape, mainly the Animal Disease Act (1881) which stipulated the isolation of livestock and cattle which suffered from contagious diseases (Mwatwara and Swart, 2015).

3.8.1.4 Contagious Bovine Pleuropneumonia (Lung Sickness)

Contagious bovine pleuropneumonia (CBPP), also referred to as lung disease/sickness in cattle, is an acute, sub-acute or chronic respiratory disease of cattle which is now considered as one of the most important trans-boundary diseases (Kairu-Wanyoike *et al*., 2014). It is considered one of the greatest plagues that continue to devastate cattle herds, which people in Africa are dependent on (Food and Agricultural Organization, 2002). The disease has severe consequences for food security and livelihoods, and poses a major constraint towards cattle production in Africa (Amanfu, 2009). In addition CBPP is considered a disease of economic importance, mainly in developing countries (Tambi *et al*., 2006). The disease has severe consequences for food security through: the loss of protein; reduced output; increased production cost due to disease control, and disruption to livestock trade (Tambi *et al*., 2006). Greater movement of cattle in the 19th century resulted in Napoleonic military campaigns and an increase in international cattle trading, CBPP spread rapidly throughout Europe via the Swiss and Dutch cattle which were favoured for breeding at that time (Egwu *et al*., 1996). Britain became infected in 1840 from an infected bull that was introduced from the Netherlands, and the disease then spread to Scandinavia, the USA and Australia in the mid-1850s (Egwu *et al*., 1996). From Australia, CBPP spread to New Zealand, China, India, Mongolia, Korea, Hong Kong and Japan during the late 19th century (Egwu *et al*., 1996).

The first appearance of CBPP in southern Africa was in the Cape aboard a ship carrying Friesian bulls into Mossel Bay during 1853 (Peires, 1987, Thiaucourt, 2004, Amanfu, 2009). From Mossel Bay the disease affected trek oxen, and alongside all trade routes until it spread towards the Northern provinces (Thiaucourt, 2004). CBPP made its political contributions towards the Great Xhosa Cattle Killing movement in 1856 to 1857 which resulted in the starvation of many Xhosas (Thiaucourt, 2004). CBPP was widespread in southern Africa by the time rinderpest appeared during 1896-97 (Thiaucourt, 2004). The rinderpest pandemic overshadowed the CBPP pandemic and the disease killed many CBPP infected cattle (Thiaucourt, 2004).

The disease is endemic in almost all countries in Africa and official controls on cattle imports have been put in place to control the spread of the disease (Daniel *et al.*, 2016). At the time that rinderpest appeared during 1896 to 1897, CBPP was extensive in southern Africa (Thiaucourt *et al*., 2004). Factors such as war, famine, water shortages and financing of veterinary services have resulted in the spread of CBPP in the East and Central African Regions (Daniel *et al*., 2016). Changing ecological and environmental factors have influenced the availability of water and grazing land and this has resulted in the movement of cattle over long distances in search for feed and water (Amanfu, 2009). The lacking resources allocated to lung sickness in cattle were further reduced. In addition, the disease threatens to have severe implications for food security, and decreased cattle production will impact severely on the livelihoods of many people (Amanfu, 2009). In Kenya, many interventions for lung sickness were used by pastoralists to control the disease. This included vaccination as the major coping mechanism, prevention of infected communal grazing, traditional quarantine and avoiding purchase of infected cattle from origin (Kairu-Wanyoike *et al*., 2014).

In the South African context, lung sickness resulted in Xhosa cattle-killing rituals, from 1856 to 1857 as the Xhosa believed that without the disease, cattle killing would not have occurred (Thiaucourt *et al*., 2004). The disease spread across ox-wagon routes along the south-western Cape to the Eastern Cape and Xhosa land (Peires, 1987). As a means of coping with lung sickness the Xhosa tribes slaughtered their cattle herds to: “avoid the risk of losing them through lung sickness” (Peires, 1987:46). By slaughtering their infected herds, this would rid their cattle of suffering from the diseases. Similarly, in Zululand, lung sickness was introduced into Natal during the mid-1850s killing thousands of cattle (Ballard, 1983).

CBPP was spread by cross border /regional cattle movements which were accountable for the distribution and transmission of CBPP from one herd region to the other (Masiga *et al*., 1996, Alemayehu *et al*., 2014). According to Amanfu (2009), changing environmental conditions including the availability of water and grazing lands led to increased cattle movements over

long distances. In addition, husbandry practices in southern Africa are also a contributing factor to the epidemiology of the disease (Masiga *et al*., 1996). Transhumance practices in arid environments such as Namaqualand (Rohde and Hoffman, 2008) and the Kalahari (Radatz, 2003) were also a contributing factor to cattle movements, which would have an impact on the spread of the disease. Cattle movement by trekking is one of the major risk factors that are responsible for the spread of CBPP (Masiga *et al*., 1996). Widespread cattle trekking, also results in cattle mixing at watering points in search of drinking water or in confined market places which poses favourable conditions for the spread and transmission of CBPP (Masiga *et al*., 1996).

As lung disease began to worsen, society began to adopt measures to cope with such impacts. In East African pastoral locations, society addressed diseases in their livestock through responses which often included migration, changes in livelihood patterns, and in some instances resorted to violence and conflict over resources (Bett *et al*., 2016). People have resorted to migration, by taking their animals to new environments where they may not be acquainted with diseases and pathogens (Bett *et al*., 2016). In some African countries, the disease is notifiable and there are immediate controls on the import of cattle to prevent spread of the disease (Daniel *et al.*, 2016)

3.9 Agriculture

According to Olesen and Bindi (2002), agriculture is located at the interface between ecosystems and society. Agricultural production around the world is regarded as the most sensitive sector to climate changes due its high dependency on climate conditions (Pei *et al*., 2016). Climate impacts are said to be detrimental for agriculture in many parts of Africa, with warming projected to reduce crop yields by 10-20% by 2050 (Jones and Thornton, 2008). Weather extremes occur in every agricultural region around the world and will pose a threat and cause damage to crops and livestock (Rosenzweig *et al*., 2001). In some developing countries climate threatens crops such as sorghum, millet, wheat and maize which are important for subsistence and maintain a dual function (Herrero *et al.,* 2010). Firstly, these crops provide a means of food for human consumption and secondly they are used as animal/livestock feed (Herrero *et al*., 2010).Livestock structures are also rapidly changing in response to a variety of drivers (Thornton *et al*., 2009). Climatic changes such as rainfall variability may cause damage to such livelihood activities, and in the context of local communities, their livelihood security, food security, incomes and access to social services are determined by performance of farming and livestock keeping activities (Mayaya *et al*., 2014).

Severe droughts have been experienced in the Middle East during 2008-09 and have resulted in a decline of crop yields by 40%, with production of wheat having dropped 45% from an average harvest (Feitelson and Tubi, 2017). As a consequence of this, food prices have increased tremendously and people were forced to depend on food imports (Feitelson and Tubi, 2017). In northern European countries climatic constraints affect the length of growing seasons in crops, and results in late spring and arrival of early autumn frosts (Olesen and Bindi, 2002). It is further highlighted that the duration of growing seasons (frost, ice or snow free periods) limits crop productivity (Olesen and Bindi, 2002). This results in lower wheat yields in Nordic countries. Agricultural risks are further increased by overnight frosts in late spring and early autumn (Olesen and Bindi, 2002).

3.9.1.1 Crop Failure and famine

Famine is defined as a phenomenon associated with mass starvation which is a result of poor harvest, which is often caused by droughts, excessive rain, cold summers and even frosts (Saito, 2010). Famine in poor economies and regions are mainly related to the impacts of extreme weather such as droughts and floods (Gráda, 2007). Historically, it has been reported that the worst famines have resulted in shortfalls of the most staple crops, for example the Great Irish Famine that struck potato crops during 1845 and 1846 (Gráda, 2007). The estimated death toll from selected famines that took place during the 19th century in Ireland, Finland, China and India is shown in (Table 3-6). In addition to weather conditions, famines were also associated with disease outbreaks such as cholera, influenza and malaria (Gráda, 2007).

Table 3-6: Selected 19th century Famines and the Estimated Death Tolls (Source: Gráda, 2007:20)

Year	Country	% Death Rate	Description
1846-52	Ireland	12	Potato Disease, policy Failures
1868	Finland	7	Poor Harvests
1877-79	China	3	Droughts and Floods
1876-79	India	3	Drought and Policy Failures

As early as the 1860s, it was reported by Sundin and Willner (2007) that there was a correlation between harvest failures and high mortality rates in pre-industrial Sweden. During 1772 and 1773, the population was hit with an extreme crop failure which recorded high death rates from famine (Sundin and Willner, 2007). However, these deaths related to starvation only, constituted only a portion of the total mortality during the famine related crises. The majority of the deaths that occurred were due to diseases such as gastrointestinal infections,

dysentery and typhus (Sundin and Willner, 2007). In comparison to Dribe *et al.* (2015), their study pointed out that during the 19th century, Finland experienced severe mortality during the following periods: 1808-09, 1832-33, 1857-58 and the famine of the late 1860s. However in contrast to the findings of Sundin and Willner (2007), which attributed deaths during a famine related crises to diseases, Dribe *et al*. (2015) highlighted that mortality was also caused primarily through warfare during periods of food shortages and bad harvests. In response to such catastrophes, the army at the time provided rescue by importing food from Russia in order to prevent hunger (Dribe *et al*., 2015). Vanhaute *et al*. (2006) related food availability to population growth, indicating that between 1750 and 1850, agricultural production rose significantly but not more than population growth.

The growth and influence of grains, and harvest also have a noticeable impact on the growth and fluctuation of the economy of a region (Holopainen *et al*., 2012). The study undertaken by Holopainen *et al*. (2012) presented evidence on the interrelationships between climate fluctuations, grain crops and prices during the 19th century. In addition to the fluctuations in climate being an influence on grain prices, other non-climatic factors such as globalisation and the emergence of international grain markets had an influence on the prices of grain during the 19th century (Holopainen *et al*., 2012).

In an African context, during the middle 18thcentury, maize was introduced into KwaZulu-Natal (Hannaford, 2014).Cultivation of maize had a dual implication of population growth at the time and increased human susceptibility to droughts due to the water-demanding nature of the crop (Hannaford, 2014). Kelso and Vogel (2007) identified severe drought in 1820, following through into 1821 in Namaqualand, which resulted in failure of wheat harvests, and were considered the worst, compared to previous years. Similarly, Nash and Endfield (2002) provided selected quotes in their research which also mentioned crop failures due to droughts during 1846 in the Kalahari region.

The severe drought during 1894-1899 in Kuruman, also resulted in crop failures, which consequently caused starvation amongst natives and as a coping mechanism, people resorted to consuming wild roots and berries (Nash and Endfield, 2002). The work by Nash and Endfield (2008) also mentioned such impacts, including food shortages, crop failures, and famine throughout the 1896 and 1897 ENSO years in the Kalahari region. In KwaZulu-Natal, below average rainfall experienced during late 1899 and early 1900s, had severe impacts on wheat, sorghum, fodder and root crops (Nash *et al*., 2015). Apart from drought having a severe impact on crops, multi-year wet periods can also impact on crop production. For example, floods may immerse hectares of farmlands in water, which results in crop failures (Christian, 2014).

3.9.2 Vermin in Crops

Vermin in crops during the 19th century were mainly in the form of locusts. This section presents cases of where such occurrences took place during the 19th century.

3.9.2.1 Locusts

The outbreaks of locusts are seen as an important threat in many regions of the world, such as Asia, Africa and Australia (Lima, 2007). Outbreaks of locusts often lead to crop failures and damage to plants in various parts of the world (Brázdil *et al*., 2014). Locust outbreaks are triggered by various climatic factors which include heavy rainfall, periods of drought and floods (Lima, 2007). Weather plays a critical role in that it allows for population growth of locusts, formation of swarms and creation of suitable levels of soil moisture which results in egg development (Simpson and Sword, 2006). The research by Bam (2014) further highlights that, outbreaks of locusts in Tanzania, slowed down during consecutive dry years. However during a season of favourable rains, egg survival is greater and pasturage conditions are also available for emerging locusts which results in an increase in population (Bam, 2014).

The common brown locust is known to be a major pest in agriculture, particularly in southern Africa (Todd, *et al*., 2002). Throughout Asia, Africa, New Zealand and Australia, migratory locusts are known to have been widespread, causing much damage to food crops (Stige *et al*., 2007). Migratory locusts also have a preference for various types of grass including cultivated crops, legumes and vegetables (Brázdil *et al*., 2014).

The main outbreaks of locusts in China have been breeding systems that were associated with marshlands, overflow channels and flood lakes connecting the Yellow and Yangtze River systems (Stige *et al*., 2007). Similarly, these river systems were also breeding grounds for locust invasions for the past 100 years, with severe outbreaks occurring during warm-dry years having warm-dry summer periods as well as warm-wet winters (Yu *et al*., 2009). These conditions were favourable for the locust eggs to be well preserved. Locust outbreaks are also linked to warm spring and summer conditions due to optimum season which allows for locusts to reproduce and disperse (Yu *et al*., 2009).

Wagner (2008) reported that during severe droughts in 1874, a plague of locusts stripped the fields of settlers in the Great Plains and Midwest in the United States. Fields of wheat, corn, turnips, potatoes, fruit and tobacco were in ruins (Wagner, 2008). Locust invasions also impacted on poultry and polluted water supplies in Nebraska (Wagner, 2008). Farmers were coping by trying to remove locust carcasses from wells in order to avoid contamination of human water for drinking (Wagner, 2008). Various efforts were made during this period to

drive off the locusts and save crops, unconventional methods included burning of fires to smoke away the grasshoppers from crops and into surrounding ditches filled with water and oil to drown them (Wagner, 2008). A variety of traps were built by farmers to get rid of the pests. Other coping mechanisms included legislation which encouraged the construction of grasshopper extermination devices while other states in America supported the protection of grasshopper eating birds such as quail and prairie chickens (Wagner, 2008). However, much to the dismay of farmers, these efforts failed and entire crops were destroyed, families starved and people were migrating to other areas to escape the plague. Furthermore, the grasshopper damage to agriculture had severe economic impacts in 1874 (Wagner, 2008).

The African environment was described as a severly hostile environment compared to other continents, and exploitation of natural resoures were limited by two factors. These include the generally thin soils of the region, animal diseases and crop pests such as major locust invasions (Green, 2013). Locusts are traditional plagues in Africa and the 19th and 20th centuries had an abundance of records of locust invasions (Mabogunje, 2000). This includes, for example, the Central African invasions which took place during 1847, 1854, 1892, 1910, 1930 and 1944 (Mabogunje, 2000). Agricultural populations were the worst hit by such invasions, prior to harvesting which resulted in famine and malnutrition (Molosiwa, 2014). In these types of instances, drought becomes coupled with locust invasions, thereby causing political turmoil in addition to social unrest (Mabogunje, 2000). Favourable maturation of locusts is usually associated with rainy, wet conditions coupled with warm temperatures (Cressman, 2013). Weather conditions also affect the behavioural patterns of locusts, with major outbreaks occurring after rainfall (Cressman, 2013).

According to Odhiambo (1991), there are at least five species of locusts in Africa namely the desert locust, the tropical migratory locust found almost everywhere in Africa, the red locust found in eastern-central Africa, the brown locust found in Southern-central Africa and the Senegalese grasshopper. The desert locust goes into recession during drier periods, and is distributed widely over semi-arid and arid areas (Odhiambo, 1991). Desert locusts require wet soils to allow the development of their eggs, therefore the development of these species of locusts is exclusive to wet periods (World Meteorological Organization and Food and Agriculture Organization of the United Nations, 2016). Notable wet periods during the 1840s could have therefore attributed to the development of the Desert locusts in southern Africa (World Meteorological Organization and Food and Agriculture Organization of the United Nations, 2016). Such desert locusts have the potential to not only cause damage to agriculture, but causes threat to livelihoods (World Meteorological Organization and Food and Agriculture Organization of the United Nations, 2016).

Locust outbreaks are triggered by various climatic factors which include heavy rainfall, periods of drought and floods (Lima, 2007). Weather plays a critical role in that it allows for population growth of locusts, formation of swarms and creation of suitable levels of soil moisture which results in egg development (Simpson and Sword, 2006). The common brown locust is known to be a major pest in agriculture, particularly in southern Africa (Todd *et al*., 2002). Locust invasions were classified to be a disaster, with upsurges threatening crop production and food security for the southern African region (US Congress, 1990). Hannaford and Nash (2016) have mapped out evidence of locust plagues (amongst other phenomena such as drought and famine) prior to the 1830s for regions specifically in southeast Africa (Table 3-7).

Table 3-7: Locust Plagues in Southeast Africa-wide prior to 1830 (Hannaford and Nash, 2016)

Period	Location	Events
1560-1590	Southeast Africa-wide	Drought, locusts plagues, food shortages, and famine
1730-1768	Zambezi valley	Drought, locust plagues, and famine
1795-1805	Southeast Africa-wide	Drought, food scarcity, and famine
1824-1830	Southeast Africa-wide	Drought, food scarcity, famine, and locust plagues

Multiple locust plagues occurred in the Zambezi Valley during the 1730s, 1740s and 1750s, which resulted in huge numbers of the population having surrendered themselves to enslavement (Hannaford and Nash, 2016). In addition, the locust pandemics have also contributed to famine and decline in food production (Hannaford and Nash, 2016). During 1895, vast swarms of red locusts swept out of north-eastern African into the coastal belt of Natal and Zululand (present day KwaZulu-Natal), and destroyed the bare fields of sugar cane and Maize (Ballard, 1983). Locust swarms between 1894 and 1895 resulted in sugar cane production and quantities being severely reduced (Ballard, 1983). In 1896, a combination of soil exhaustion and locust infestations affected the yields of raw sugar production in Natal, which may have contributed to the fall in sugar exports that year (Ballard, 1983; Richardson, 1982).

Ballard (1983) reported that in KwaZulu-Natal, particularly Zululand, locust invasions during 1895 were exacerbated by the drought impacts of that year, which resulted in loss of pasture land, deaths of livestock, planting delays, and delay in sowing of crops. During 1896-97, Zululand continued to experience persistent dry conditions, and in addition to this, there were vast locust plagues which also impacted on agriculture (Nash *et al*., 2015). The locust plague impacted severely on peasant communities, causing destruction to large portions of subsistence crops such as maize and sorghum (Ballard, 1983). The effects of this led to widespread malnutrition, indebtedness, increased migrant labourers and starvation (Ballard, 1983).

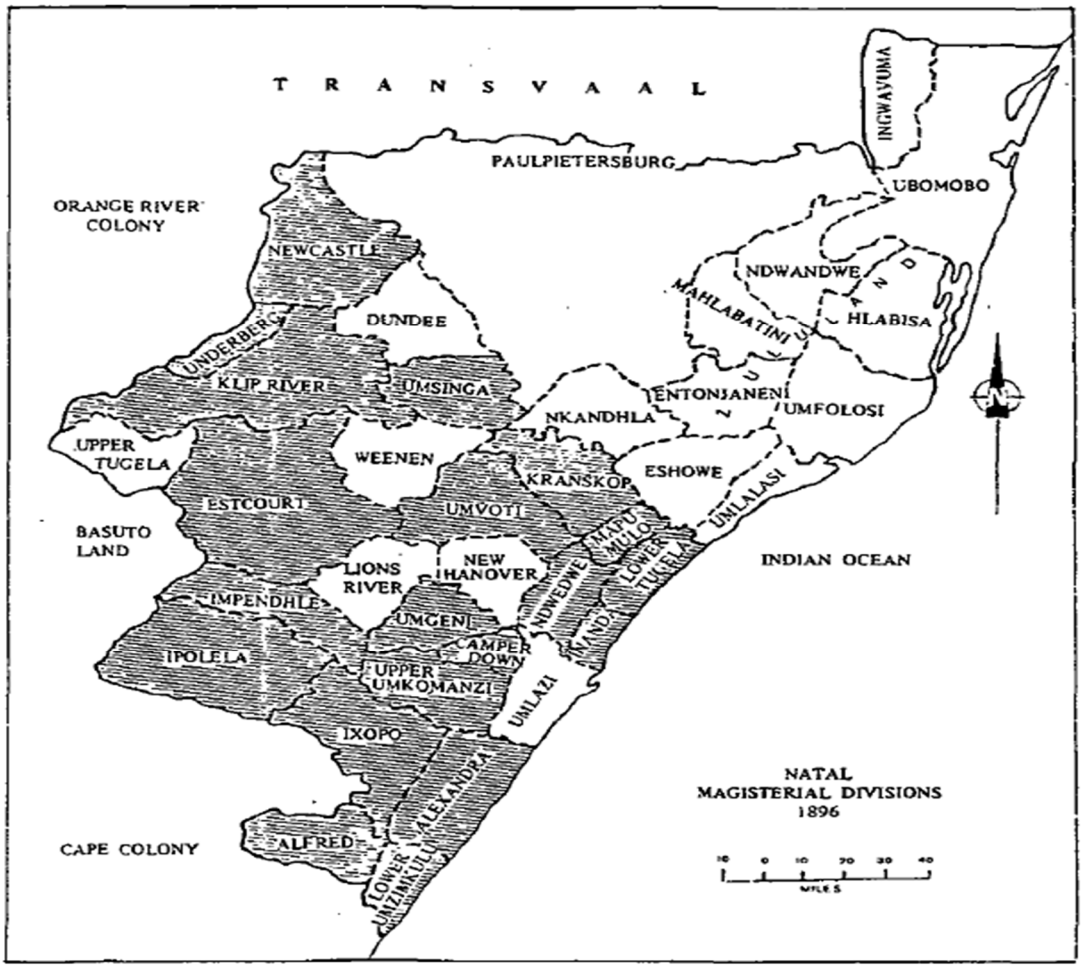


Figure 3-3: The Natal Colony in 1896, indicating divisions that sustained 30% or more crop losses due to locust invasion(Source: Ballard, 1983:4)

It was reported that the black population residing in the 18 divisions that were affected by crop losses due to locusts, were estimated at 432 973 (Figure 3-3) or equating to 76% of the total African population in KwaZulu-Natal (Ballard, 1983). The locust plague of 1896 also made peasants highly vulnerable to rinderpest and it resulted in material and financial losses. In periods of drought and lack of rainfall, conditions were further exacerbated by locusts in portions of Namaqualand and the Cape Colony (Vogel, 1989). Similar patterns were observed to that of KwaZulu-Natal, noting that locust invasions were seen as disastrous, having further exacerbating famine, and impoverished farming land. The work of Nash and Grab (2010) also

reported locust plagues during 1865, which caused annihilation towards the so called 'Indian crops' in Lesotho.

3.10 Response to climate impacts

Concepts such as adaptation, coping mechanisms and exposure all fall within 'vulnerability science' and have a crucial bearing on the study, and will thus be unpacked and introduced in this section.

3.10.1 Adaptation and coping

As relatively intertwined concepts which are often used interchangeably in the context of climate change, to name a few, vulnerability, adaptation, coping, resilience, and historical ecology, have gained much momentum in their ability to link paleoclimatic, paleoecological, historical and archaeological sources (Hannaford *et al*., 2014). Mitigation and adaptation to climate change are two fundamental response options for reducing the risks and management of disasters which are associated with climate change (Füssel, 2007; IPCC, 2012). Adaptation is viewed as one of the key concepts in much of the literature associated with livelihood changes and climate change (Reenberg *et al*., 2008). Reducing the risks from natural hazards is one of the major concerns and challenges that society is faced with, in light of current global environmental changes (Birkmann *et al*., 2013). Societies will have to adhere to and continue living with changing environmental circumstances through adaptation and coping mechanisms (Birkmann *et al*., 2013). All societies and related human activities are sensitive to climate in different ways (Adger *et al*., 2003a). This is also due to the fact that, where people live and generate a livelihood is largely influenced by the ambient climate of that particular region (Adger *et al*., 2003a). Since the climate is inherently variable for natural reasons, societies have always had to develop coping strategies in the face of climatic extremes (Adger *et al*., 2003a).

It is important to distinguish between climate change adaptation, and coping in order to determine how society responded to climate change through time. This also becomes important in the context of this research in order to define and draw differentiation between what the coping and adaptation mechanisms were during the 19th century. According to Easterling *et al*. (2004), historic responses to environmental and climate change can shape the means in which society will adapt to future climate change. In some parts of the African continent, Africans developed and adopted new strategies and means to cope with disease environments, as well as frequent drought and floods (Kwashirai, 2013). Such historic responses by traditional and indigenous societies (who have survived over long periods of time to climatic changes) offer lessons which are valuable to understanding adaptation

practices in the context of climate change (Macchi *et al*., 2008). In addition, episodes of cyclical droughts and floods across Africa influenced the growth of historical environmental literature on climate and ecological changes, coping mechanisms and responses towards environmental catastrophes (Kwashirai, 2013). There is much value in historical, climate-society research in that it provides a bottom up approach which further explores the vulnerability and resilience of societies towards climate change and how such societies were framed, responded and adapted to, and coped with such changes (Hannaford and Nash, 2016).

3.10.1.1 Adaptation as a response to climate change

Adaptation is increasingly becoming the centre of discussions around human responses towards the impacts of climate change (Heyd and Brooks, 2009). Adaptation to climate change is not something new and adapting to environmental change is viewed as being an ultimate human trait (Easterling *et al*., 2004). The element of culture plays an integral part in understanding both mitigation and adaptation to climate change (Adger *et al*., 2012). The consequences and impacts of climate change are given greater meaning through cultural interpretations of science as well as risks (Adger *et al*., 2012). Adaptation methods are those which take precedence over the longer-term and enable individuals or communities to adjust to the impacts of climate change in local areas (Nyong *et al.,* 2007). Such actions in the context of adaptation, includes environmental resource management practices comprising the planting of early maturing crops, adoption of varieties of crops and selective keeping of livestock in areas which experience declining rainfall (Nyong *et al*., 2007). Adaptation may also include consideration of alternate technology that enables individuals to function and respond to new and changing environmental conditions (Nyong *et al*., 2007).

Taremwa *et al*. (2016) define adaptation as "*adjustments of a system to reduce vulnerability and to increase the resilience of a system to change, in this case the climate system*" (p: 168). Adaptation may also refer to the efforts that are made by society or ecosystems to prepare for or adjust to future climate change (Posas, 2007; Taremwa *et al*., 2016). Over the progression of human history, individuals and societies have adapted to climate change and will continue to do so, because climate is a factor which forms part of the broader environmental landscape of human existence (de Menocal, 2001; Adger, 2003b).

3.10.1.2 Coping as a response to climate change

Coping is often seen as an aspect to resilience that implies "here and now" capacity and immediate response (Birkmann *et al*., 2013:196). Coping determines levels of vulnerability at any moment in time and includes managing of resources usually during short periods of time

under adverse conditions (Wisner *et al*., 2003). Furthermore, coping is seen to address the conservation and protection of current systems and institutional settings (Birkmann *et al*., 2013). Eriksen *et al*. (2005) associated coping strategies with activities which are aimed at either obtaining food or a means of income during times of stress, either by means of production or through formal and informal exchange. These coping strategies are further related to agriculture and economic production, social variations such as bartering /economic exchange and biological strategies such as changing diets or reducing consumption patterns (Eriksen *et al*., 2005).

Adaptation, in contrast to coping, symbolizes a longer-term and continuous process of learning, sharing, experimentation and change which responds to vulnerability (Birkmann *et al*., 2013). The process of adaptation plays a role in shaping all aspects of vulnerability while remaining apparent throughout the consequences of learning, during and after a disaster (Birkmann *et al*., 2013). The following characteristics (Table 3-8) summarizes adaptation and coping which will be considered in this study. Adaptation is viewed as a long term response to climate impacts, which includes long term planning, while coping is seen as an immediate, short term response which is reactive.

Table 3-8: Comparison between coping and adaptation (Source: Cooperative for Assistance and Relief Everywhere (CARE), 2009)

Coping	Adaptation
Prompted by lack of alternatives	Orientated towards a longer term security of livelihoods
Immediate, Short term responses	A process which is continuous
Leaning towards survival	Involves long term planning
Not Continuous	Combines strategies and knowledge which are both old and new
Motivated by a crises , reactive	Focused on determining alternatives

3.11 Examples of coping and adaptation

During the past centuries, many people first sought alternatives for pre-existing coping strategies some of which were questioned in terms of their sustainability by Europeans (Molosiwa, 2014). Indigenous famine coping strategies involved eating bark, roots, caterpillars, and even decayed cattle corpses (Molosiwa, 2014). Hunting was also viewed as a means of household subsistence and was seen as a supplementary measure to normal diets (Molosiwa, 2014). Hunting as a coping mechanism was more extensive during periods of famine when food became scarce; however disease such as rinderpest prevented hunting of affected cattle (Molowisa, 2014).

3.11.1 Migration

Gemenne and Blocher (2016) highlighted that studies have considered migration to be a positive process which is aimed at adjusting to changes. Burrows and Kinney (2016) on the other hand, argue that a growing body of academic literature breaks down various factors of migration which are seen as drivers. Such factors include those that endorse out-migration for example: environmental conditions, political unsteadiness, social conflict, and lack of economic opportunities. The factors which attract migrants include: economic and job opportunities, demand for resources, and political steadiness (Burrows and Kinney, 2016).

However, a fundamental theory to climate change-induced migration remains, and it assumes that changes in the environment can be a force that drives individuals/societies to leave their homes, as environmental pressures can result in limited resource availability, making a place less desirable to live in (Tacoli, 2009; Burrows and Kinney, 2016). It is further reported that migration can be regarded as an ancient societal response to environmental and other changes and can be seen as a coping mechanism which has been used throughout history by societies (Liehr *et al*. 2016; IPCC, 2012). Pei and Zhang (2014) argue that if the climate changed, migration was the only means for nomadic communities to adapt, as migrating to a place where there is sufficient grass and water availability would allow them a means of survival. Climate induced migration is attracting growing interest and is increasingly being debated. Such arguments are also reflected on the work by Reuveny (2007), who reported that factors leading to environmental migration are underpinned by land degradation, drought, water scarcity, famines and deforestation.

The IPCC (2012) relates migration as both a condition of, and a response to, vulnerability – especially political vulnerability which is formed through conflict, and which can drive people from their homelands. The process of migration is seen as being part of a community's resource utilization strategy as a means to cope with climatic variability (Adger *et al*., 2003a). Migration patterns are very specific and may be driven by certain motives and socio-ecological conditions, and in addition, migration is driven by socio-economic conditions (Liehr *et al*., 2016). Drought induced migrations were a result of people searching for food or water elsewhere, however such migrations were often carried with a risk of clashes or social unrest with adjacent groups, over grazing pastures or water resources (Papaioannou and de Haas, 2015). Food shortages and increasing food prices also prompted conflicts and decline in population numbers (Zhang *et al*., 2007).Feitelson and Tubi (2017) have reported that societal responses to droughts in the Middle East included massive migrations of approximately 1.5 million people to the outskirts of towns and urban areas.

The research by Jennings and Gray (2015) argued that there are only a few studies that have used historical data to draw a link between climate change and migration patterns. This is further hampered by limitations in data that are available (Jennings and Gray, 2015). However, their data used longitudinal individual-level demographic data from the Historical Sample of the Netherlands (HSN) and climate data to examine the effects of climate variability on migration, using event history models for the 19th century in the Netherlands (Jennings and Gray, 2015). The findings of this study highlighted that during 1865-1937, high temperatures and low rainfall increased long distance movement in the Netherlands, while in the later period (1901-1937), the results are reversed as high temperatures decrease migration amongst rural dwellers (Jennings and Gray, 2015). During earlier periods of the study, patterns of migration increased with positive conditions such as high temperatures and low rainfall, which enabled people to overcome steep barriers to long distances (Jennings and Gray, 2015). The findings of the study also showed that negative environmental conditions triggered migration patterns, given that rural populations often depended on agricultural production (Jennings and Gray, 2015).

Glaser *et al.* (2017) also studied climate-induced migrations from southwest Germany to North America during the 19th century. The study considered climatic conditions as well as socioeconomic and political issues such as decrease in crops yields, inflation in cereal prices and emigration patterns. During the years 1829-1833, the number of migrations recorded showed a significant increase due to unfavourable climatic conditions causing an increase in frost days in Stuttgart and Karlsruhe (Glaser *et al.*, 2017). Harvest conditions during 1830 and 1831 were described as deficient which led to famine conditions in Stuttgart (Glaser *et al.*, 2017). Economic impacts such as rising grain prices from harvest failures also triggered migration during 1830-1831 (Glaser *et al.*, 2017). The failure of potato harvests between 1845 and 1847 placed an additional burden on food security and resulted in pressure on grain markets (Glaser *et al.*, 2017). Migrations during these times were mainly triggered by climatic conditions (hot and dry summers) through the effects on harvest and inflation of food (Glaser *et al.*, 2017).

Migration was also viewed as an important response measure in North China during the late 17th century, mid-18th century, the turn of the 19th century and during the 1860s-1900s (Xiao *et al*., 2015). Migration was reported to have occurred extensively during the 1860s-1900, with popular destinations being central and Eastern-Inner Mongolia and the three provinces of Northeast China which are located to the north of the Great Wall (Xiao *et al*., 2015).

Mass emigration was also a central feature of the famine years in Ireland. Between the mid-1840s and mid-1850s, nearly two million people left Ireland for good (Grada, 1992). Most

people migrated to the United States, but Great Britain and Canada also became desirable destinations. By 1851, the United States had nearly one million Irish-born people (Grada, 1992). Alpino *et al*. (2016) mention that historically prolonged droughts supplemented mass movement of populations into urban areas. Populations were unable to sustain their families in rural settings due to reduced food supplies, harvest losses, death of livestock and income deficiencies (Alpino *et al*., 2016).

3.11.2 Farming techniques

Many farming communities may cope with climatic changes and even prepare for climate change through various adaptation techniques, such as using crop varieties which are tolerant to drought, water harvesting techniques, mixed cropping, extensive planting, wild plant gathering, and other traditional farming practices as a response to climate change (Altieri and Koohafkan, 2008). In some regions globally, farmers have developed agricultural systems which are adapted to local conditions which enables them to continue to produce yields that meet their subsistence necessities (Altieri and Koohafkan, 2008). The research undertaken by Pei *et al*. (2016) examined crop yields in Eastern and Western Europe during AD 1560–1660. Their study established that crop selection was a means of adaptation to climatic changes by identifying cold resistant crops as a feasible means of adaptation to meet subsistence needs (Pei *et al*., 2016).

Local farmers in developing countries have significant roles to play in soil conservation and water management as they are highly diverse (Koohafkan and Stewart, 2008). Adaptation strategies such as indigenous soil and water management practices were developed (Koohafkan and Stewart, 2008).

Figure 3-4 summarizes the development of indigenous soil and water management practices (Koohafkan and Stewart, 2008). The figure indicates that when soil moisture and fertility are low, indigenous practices focus on soil management and water harvesting (Koohafkan and Stewart, 2008). When soil moisture is low but fertility is high, water harvesting is prioritized. In scenarios when soil moisture is less constricted, the focus is on fertility and water maintenance (National Institute for Communicable Disease, 2016).

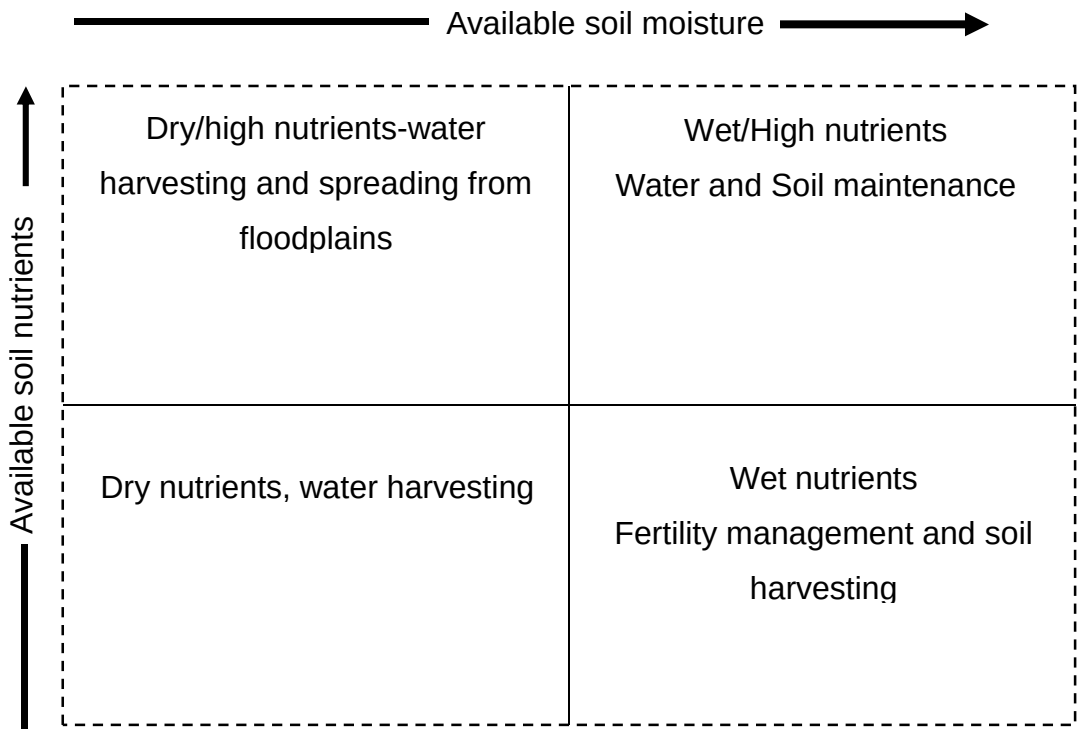


Figure 3-4: Indigenous Soil and Water harvesting Technologies as affected by Soil and Fertility Moisture (Koohafkan and Stewart, 2008)

The Chumash Indian societies in South America, engaged in numerous coping strategies to reduce risk and impacts of climate change (Gamble, 2005). This included reliance on a variety of plants and animals to avoid hunger and starvation (Gamble, 2005). One other coping mechanism was the storing of food. The Chumash and other Californian Indian communities stored food such as acorns, dried and smoked fish, and seeds in both indoor and outdoor storage facilities (Gamble, 2005). This technique of storing food allowed the Chumash to have reliable food sources to support populations throughout the year and during periods where there may be unpredictable harvests and food shortages (Gamble, 2005). Acorns were regarded as a primary staple diet of these communities as they can be stored for several years, thus when assessing the effects of paleoclimatic changes on humans, it is important to consider the direct effects of climate stresses on such core resources (Gamble, 2005). Water which is a valued natural resource and one that is most compromised during extended drought periods, was also stored by these communities. The most common technique used was a twined basketry water bottle with a bituminous lining in the interior (Gamble, 2005).

In the African context, Mayaya *et al*. (2014) studied adaptation techniques in Tanzania's Dodoma region. This region is often susceptible to persistent droughts and a lack of rainfall. Some of the miscellaneous techniques adopted by the locals were crop selection (which was the most common technique and extensively adopted), the use of drought resistant seeds,

new planting dates, tillage practices, intercropping and crop rotation techniques, and management of water loss (Mayaya *et al*., 2014).Similarly, Simbarashe (2014) identified that in Zimbabwe's Bikita district, floods and mid-season sustained dry spells were experienced during the same season. Many peasant farmers in Bikita responded to climate variability by diversifying their crop range, substituting drought resistant crops such as rapako, millet and sorghum which are drought tolerant and insensitive to temperature increases (Simbarashe, 2014). In central Africa, Rwandan farmers depend on farming systems which are more traditional in nature (Taremwa *et al*., 2016). Such examples include mixed farming and cropping, crop rotation, mulching, bush fallowing and cultivation following seasonal rainfall patterns. In the context of Rwanda, these techniques are important to safeguard against risks such as droughts, food insecurity, hunger and famine (Taremwa *et al*., 2016).

3.11.2.1 Responding to drought

An example of a response to drought during the 19th century, Bombay included government responses implemented through the purchase and sale of grain during famine (Adamson, 2014). Institutional responses also included famine relief during which large donations of food were provided in metropolitan centres in Bombay (Adamson, 2014). Drought policies were also implemented during 1790-92 and 1803, which featured grain trade and the ban of grain export from famine affected areas (Adamson, 2014). After 1830, famine responses became less reported in Bombay and various documentary records described interventions aimed at addressing water shortages which included clearing of tanks and digging of new wells, in addition to laws being introduced by the government to control water usage (Adamson, 2014).

Xiao *et al.* (2015) reported that in Northern China, governmental efforts were provided as a coping mechanism to relieve disasters. Food distribution was effective, and the Qing government established stringent regulations for food supply during the 18th century which proved to be important during extreme disasters (Xiao *et al.,* 2015). The 1743 drought in the Hebei Shandong and Henan provinces highlighted that government relief measures were maintained for eight months and 2.36 million dan (one dan = 50 kg) of grain was distributed to more than two million victims of the drought (Xiao *et al.,* 2015).

3.11.2.2 Water harvesting

Pandey *et al*. (2003) described indigenous rainwater harvesting techniques in regions such as South Asia, which was a common practice for at least 8000 years. Rainwater harvesting as a means of adaptation in India has been a long lived practice during fluctuating climatic periods and was essential for food production (Pandey *et al*., 2003). During the period 1856-1885, techniques of constructing pucca tanks were noted in the Indian city of Jodhpur (Pandey *et*

al., 2003). The year following the Orissa famine, five large reservoirs were constructed (Pandey *et al*., 2003). During 1874, there were various artificial lakes that were built and a dam was constructed for irrigation purposes (Pandey *et al*., 2003). Similar patterns of adaptation were reported by Liverman (1999) for various drought episodes experienced during the 1900s in Mexico. The local communities in Mexico established various traditional mechanisms for coping with droughts; such mechanisms include irrigation systems to store and transport water to settlements and agricultural lands (Liverman, 1999). In addition, farmers coped with drought conditions by selecting maize that was adaptable and resilient to rainfall conditions as well as by adjusting the density of crops grown (Liverman, 1999).

3.11.3 Cultural responses in adapting to climate change

The consequences of climate change have not only affected the social, economic and political facets of life in Africa, as discussed earlier, but in addition, it has also impacted on the traditional religious practices on the continent (Christian, 2014). It has impacted weather which was traditionally predictable, affected the patterns of farming and agriculture, and has changed the seasons of rituals and festivities. African traditional religion has found expression in nature, and the ability to communicate and interact with nature (Christian, 2014). Any changes to nature would have an effect on traditional African cultural practices (Christian, 2014).

Research that has been undertaken on historical environmental and climate studies alongside socio-cultural history provides a useful understanding on the manner in which humans respond to changing environments (Kelso and Vogel, 2015). Over the course of history, culture is seen as a driving factor shaping the manner in which humans perceive, understand, experience and respond towards key elements in society (Roncolli *et al*., 2009). Culture is seen as serving an important role in mediating human responses to environmental changes (Heyd and Brooks, 2009). Traditional communities and societies have built up much knowledge over long periods about environmental and climatic changes and have developed elaborated strategies to efficiently cope with and respond to these changes (Macchi *et al*., 2008).

Culture, as defined in this context, includes ways of involving values, beliefs, practices and material items that condition the production of tangible and intangible goods that are required for meeting the requirements and needs of society (Heyd and Brooks, 2009). Similarly, as defined by Chang *et al*. (2011), culture in the context of climate change is seen as a specific manner in which individuals adapt to the local environment. Cultural responses may also include the use of indigenous knowledge, which refers to knowledge that is rooted into local cultures which are generally linked with communities that are long settled in certain areas and

who have strong ties with the natural environment (Orlove *et al*., 2009). A detailed local level environmental history plays an important role in broadening the understanding of identifying what adaptation actions contributed towards enhanced resilience in the past (Kelso and Vogel, 2015). Particular cultural patterns are a factor which differentiates between human groups, and plays a role in the ability of these groups to cope with severe environmental changes (Heyd and Brooks, 2009).

3.11.4 Traditional rainmaking

Much significance is given to ritual practices in African societies (Babane and Chauke, 2015). Rainmaking is regarded as an ancient science which could through religious beliefs and prayers, appeals to the God of rain, and request rain through ritual practices (Semenya, 2013). Traditional rainmaking is one of the essential elements in African traditional religious practices (Christian, 2014). Rain is also important for survival of human, animal and plant life and rain has therefore become an important focus of religious practice in Africa (Christian, 2014). Rainmaking is often conducted during extended periods of droughts (Kwanya, 2014; Babane and Chauke, 2015). The concept of traditional rainmaking originated from indigenous observations and interpretations of meteorological phenomena that have guided the seasonal and inter-annual activities of local communities (Kwanya, 2014). This rainmaking act is defined as a form of magic or prayer which humans can use to influence weather conditions to cause rain (Kwanya, 2014), and may have developed from communities living in arid or semi-arid regions as a means of coping with drought conditions. Such an example symbolizes cultural responses towards extreme events and natural disasters. Hannaford and Nash (2016) point out that rain-control is an act which is based on an idea that humans had powers and capability to influence spirits, god or the ancestors who brought or suspended rain through rituals which involved the act of rainmaking. Rainmakers are defined as those special people who have the powers to undertake and perform the art of rainmaking (Semenya, 2013). In traditional southern African tribes these people are often referred to as “rain-makers” or “rain doctors” (Semenya, 2013).

In Ringa, Zimbabwe, Christianity and traditional beliefs form the two largest religions in the area (Matsuhira, 2013). Most of the people in this region are farmers and grow crops such as maize, sunflower, nuts (ground), beans, pumpkins, tobacco and other crops (Matsuhira, 2013). A calendar year for them comprises of two main seasons, which are a rainy season and a dry season. The rainy season begins at the end of October and the dry season begins in April (Matsuhira, 2013) (Table 3-9). The farmers begin to cultivate at the end of September, subsequently seeding begins in October or November and weeding proceeds until crops begin to grow (Matsuhira, 2013).In some village clans, the blessing of the seed would take place to

protect the coming harvests from any destructive parasites, pests or diseases (Rafapa, 2008). During the dry season it is observed that the farmers conduct three annual rituals which are rainmaking, thanks giving and the ritual which involves praying and calling for calm winters (Matsuhira, 2013). The rainmaking rituals were known to be a traditional ceremony which was part of the preparations for the farming seasons.

Table 3-9 Farming Calendar (Adapted from: Matsuhira, 2013)

Month	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug
Season		Rainy Season						Dry Season				
Farm Work		Ploughing, Weeding, Seeding					Harvest					
Rituals	Rainmaking Ploughing						Thanksgiving			Pray for Rain		
Rainfall in Harare (mm)	6.5	40.4	93.2	182.7	190.8	176.30	99.1	37.2	7.4	1.8	2.3	2.9
Average Maximum Temperature	28.4	28.8	27.6	26.3	26.2	26.0	26.2	25.6	23.8	21.8	21.6	24.1
Average Minimum Temperature	11.7	14.5	15.5	15.8	15.8	15.7	14.5	12.5	9.3	6.8	6.5	8.5

The rain making ceremony has a religious element to it. Most people in the area are farmers and utilize agriculture for subsistence. They engage in prayer for good rains, with the hope for not too much or not too little. The rain, however, cannot be controlled by people, but their beliefs were that the only way to have a good harvest was to pray for it (Matsuhira, 2013). Interestingly, during drought and political conflicts, people believed that royal ancestors were responsible for bringing the rain forth and they also had power to withhold it (Vijfhuizen, 1997). It was argued that conflicts between chiefs of certain villages were thought to be the cause for drought (Klein *et al*., 2016). Social conflicts resulted in chiefs not worshipping the ancestors, who then caused them to not provide rains; it is believed that the ancestors have power and control of releasing the rains (Vijfhuizen, 1997). In addition, Vijfhuizen (1997) pointed out that the very old people referred to the conflicts and droughts which existed in past centuries, indicating that people in the past centuries had nothing apart from skins to wear. It was further highlighted that many droughts were caused through conflicts between family members, brothers or chiefs of villages.

3.11.5 Using Indigenous knowledge as a means of climate adaptation

Many African communities have extended indigenous knowledge which has been passed on from generation to generation (Taremwa *et al*., 2016). Such communities recognized and

understood the weather patterns and could easily predict how and when local natural disasters would be likely to occur and how to plan ahead in order to cope with their impacts on livelihoods and the natural environment (Taremwa *et al*., 2016). Indigenous knowledge systems in Africa are applied in conjunction with the natural as well as the spiritual domain (Taremwa *et al*., 2016).

In parts of southern Africa, indigenous knowledge and forecasting has been used widely to determine climatic forecasts, and in order to develop interventions for coping and adaptation (Jiri *et al*., 2016). This type of knowledge includes structures of information and a manner of understanding which guides human interactions with the environment through farming activities, fishing, hunting, natural resource management as well as interpreting and understanding natural weather phenomena (Theodory, 2016). Such Knowledge also paves the way for adaptation strategies to respond to changing environments (Theodory, 2016). Furthermore, indigenous knowledge appears to be location specific, and transferred within and between generations (Chanza and de Wit, 2016).

Chanza and de Wit (2016) further highlighted that in some African societies, land use practices are intertwined with cultural beliefs under the authority of local traditional healers, which is referred to as "*environmental spiritual connection*" (p:3). These forms of spiritual rules are thought to condemn the misuse of, and unsustainable, land practices (Chanza and de Wit, 2016). Some farmers in the African region have also used indigenous forecasts to articulate expectations on weather and climate (Jiri *et al*., 2016). What is particularly interesting is the use of proxy indicators such as tree phenology, animal behaviour patterns, wind circulation, cloud cover and social indicators to determine weather conditions, rains and season quality (Jiri *et al*., 2016).

3.11.6 Traditional knowledge indicators

Vegetation indicators have been used broadly in southern Africa to determine and predict rainfall. Past studies show that local El Niño events have shifted flowering patterns of trees (Curran *et al*., 1999). Similarly, Jiri *et al*. (2016) have shown that locals in southern African regions make use of tree phenology and tree shifting patterns as a means for seasonal forecasting. For example, if certain trees/shrubs bear fruit at a certain period, provides an indication of good or poor rainfall seasons (Jiri *et al*., 2016). The work by Kolawole *et al*. (2014) provides a good indication of traditional responses through the use of tree phenology. The tree referred to in this study is the 'brandy bush'. Early bearing of fruits on this tree indicates that there will be low rainfall in that year. Yet if the tree bears fruit around February /March then this indicates that there will be plentiful rainfalls in that year (Kolawole *et al*., 2014). If the

tree bears no fruit at all this foretells a serious danger that a drought will occur in that respective year (Kolawole *et al*., 2014).

Similarly, animal behaviour patterns are also used as an indicator for the onset of rains in southern African regions (Jiri *et al*., 2016). Research by Orlove *et al*. (2009) indicated that the arrival of migratory birds in parts of Africa displayed signs that there will be heavy rains, particularly the Abyssinian hornbill in Zimbabwe, Zambia and northern parts of South Africa. Some other examples relevant to southern Africa include the appearance of red ants with rapidly increasing sizes of moist anthills which anticipates that good rains are coming (Jiri *et al*., 2016).Weather forecasting and prediction in South Africa using traditional climate prediction indicators may also include the behaviours of domestic animals such a grunting of pigs, appearance of certain snakes moving down mountains, and frequent appearances of tortoises which are all signs that there will be good rains to come (Zuma-Netshiukhwi *et al*., 2013) (Table 3-10).

Table 3-10: Traditional weather forecasting in South West Free State in 2008 and 2012 (Zuma-Netshiukhwi *et al.*, 2013)

Indicator Used	Traditional Prediction	Month of Occurrence	Action
Appearance of Plants and Fruit Trees	Above average blossoming of fruit trees example, peach, apricot	September	
	Development of young leaves, grass, and sprouting of aloe ferox are indication of good rains		Spring season, preparation for sowing in November
	Flowering of wild lilies gives an indication that	September	
	Dropping of fruits before maturity indicates very dry season or drought must be expected	September/October	Consideration of drought tolerant crops and varieties with a shorter growing season.
Structure of Soil/Dryness	Soil well moistened tested by hand	October-December	Introduce seeds or seedlings under wet watered soils
Water Sources	Drying up of springs, wells, river, and wetlands is an indication of good rains	Spring	Farmers can use this to prepare for a good rainy season and plan their farming activities.
Birds	Appearance of sparrows, Flocks of swallows Migration and immigration of birds indicates a good sign of rainfall	October-March	Rainy season is approaching and farmers should prepare for this accordingly.
Wind Swirls	High frequency of winds indicates good rains are approaching	October-November	Favourable for planting season, farmers should prepare for their planting

During the 1975, 1987, 1988, 1995 and 2001 rain seasons, floods occurred in South Africa, while droughts were recorded in 1963, 1979, 1983, 1997, 1998 and 2002, as recalled by elderly people in the South-Western Free-State (Zuma-Netshiukhwi *et al*., 2013). There was no long-term climatic data for such events and traditional rainfall indicators were mentioned by the farmers through descriptions about the meteorological conditions (Zuma-Netshiukhwi *et al*., 2013). These descriptions (Table 3-10) included short-term seasonal forecasts that could have been used to improve on farming situations given unpredictability of the weather (Zuma-Netshiukhwi *et al*., 2013).

Table 3-11: Months of the year during which farmers' use agricultural timing before influence of climate change (Zuma-Netshiukhwi *et al*., 2013:393)

Month of the Year	Terminology Used for metrological Indication
January	Intense agricultural activities. Weeding and planting of field crops are taking place.
February	Preparation for harvesting as crops reaches maturity. Abundance in agriculture.
March	Produce and Pasture whilst animal are fattening
April	Vegetation is drying up and rains are becoming scarce
May	Very cold conditions-frosts and chilling of crops
June	Leaves are shedding from trees-windy conditions protruding
July	Expected rains
August	Cultivation of fields-budding of trees, and plants
September	Appearance of first rains-crops starting to germinate
October	Crops have germinated above 50cm
November	Intensification of agricultural activities, insects are observed to be producing offspring
December	Cultivation of land for future food consumption, grass growing

Cultural responses to environmental changes provide a perception into the vulnerability of modern society and the importance of preparing for the future, as reflected in the literature covered. Religious beliefs have a major role to play in empowering and enabling societies to take necessary measures to address climate change impacts and causes in a traditional, ethical manner (Posas, 2007).

3.11.7 Summary

This chapter covers the various impacts and consequences that society faces around the world. From the literature that has been studied, there have been various documented cases on societal impacts and consequences from changing climates (Gerrard and Petley, 2013, Dewan *et al.*, 2013; Diaz and Trouet, 2014; Kelso and Vogel, 2015; Grau-Satorras *et al*., 2016; Cui *et al.,* 2017). This literature review also assesses the responses from a coping and adaptation perspective to understand how society reacted towards impacts and changing climates (Vijfhuizen, 1997; Matsuhira, 2013; Papaioannou and de Haas, 2015). Culture plays an important role in past societies, as it combines indigenous knowledge with local cultures

and communities in their interactions with the environment (Orlove *et al*., 2009). In a cultural context the use of indigenous knowledge has helped many indigenous societies to cope and prepare for their livelihoods. Such indigenous knowledge was shaped by cultural beliefs and spiritual connections with nature.

4 METHODOLOGY



4.1 Introduction

Documentary evidence from historical periods is one of the major sources of evidence available for the study of past climates (Jones, 2008). Historical records and observations in documentary form are known to contain a wealth of information on past climatic conditions and contribute to knowledge on past climatic variability (Bradley, 1991; Druckenbrod *et al*., 2003; Hannaford *et al*., 2015). Climatic reconstruction is based on qualitative analysis of narratives found in historical documents which is the primary methodology of this Masters dissertation (Norrgård, 2013). Historical documents contain valuable information pertaining to a more recent history of climate (de Kraker, 2006).

Chronicle descriptions such as letters, reports, journals, diaries and personal memoirs that have been written by travellers, missionaries and settlers are regarded as the best sources of information (Norrgård, 2013). Through such sources of information, individuals infrequently recorded weather as preference was given to written descriptions of climate which was provided in greater content and form. Description of the weather was often through seasonality of rains, while other travellers mentioned and described difficult situations such as droughts and famine.

Most importantly, this work will build on existing historical projects/research that has already been completed. These include documentary-based historical climate reconstructions for the Kalahari (Nash and Endfield, 2002; Endfield and Nash, 2002; Nash and Endfield, 2008), Lesotho (Grab and Nash, 2010; Nash and Grab, 2010), Karoo (Lupini, 2015), Namaqualand (Kelso and Vogel, 2007; Kelso, 2010; Kelso and Vogel, 2015) and KwaZulu-Natal (Klein *et al*., 2016; Nash *et al*., 2015). The study further aims to examine a human-social component by drawing impacts and consequences related to climate extremes and adaptation/coping mechanisms adopted during the 19th century in the various southern African sub-regions. This research study will adopt a similar methodological approach to that used by Kelso and Vogel (2007), Grab and Nash (2010), Nash and Grab (2010) and Kelso and Vogel (2015), although considerable adjustments are included to accommodate for a somewhat different focus to these former studies.

4.1.1 Data sources

The study involved collecting historical records that reflect social consequence and responses from the published historical projects. The raw data from these projects was sorted by the relevant authors and provided for the context of this study. The sources of information used will make reference to the primary sources of information that has already been collated and used by the previous historical projects undertaken. These records include historical documentary records such as journal articles, missionary journals, Cape of Good Hope Blue Books (Blue Books of South Africa 1821-1909), historical research projects, government annual reports, newspapers and newsletters (Kelso and Vogel, 2015; Grab and Nash, 2010). Existing collected historical records reflecting societal consequences and responses will also be used. Published 19th century climate chronologies were used to make associations with known ENSO events as well as other related climate events such as drought and floods. In addition, other published works done were used as a cross reference to compare and contrast impacts and consequences.

The primary data sources used for conducting climate chronologies in the Kalahari region comprised of published and unpublished records by hunters, travellers, explorers and missionaries who travelled central southern Africa during the early 1800s (Nash and Endfield, 2008). These primary sources of data were the only written records of the Kalahari environment during the 19th century (Nash and Endfield, 2008). Nash and Endfield (2002) have used information that was derived from published materials which also included unpublished archival sources of information. The primary data used for their study included written materials by missionaries who were working for London Missionary Society (LMS) and Wesleyan Methodist Missionary Society (WMMS), among others. Reports of the LMS were

also used for the following periods (1847, 1850, 1851, 1852, 1861, 1862, 1864, 1868, 1874, 1885, and 1897) (Nash and Endfield, 2008). Such materials comprised of: unpublished reports, personal writings, and written correspondence from southern Africa to the LMS and WMMS head offices in London respectively (Nash and Endfield, 2002). The data used by Nash and Endfield (2002) and Nash and Endfield (2008) were also used for this study in order to extract and formulate the chronologies for societal impacts and consequences, as well as adaptation and coping for the 19th century. Nash and Endfield (2008) further reveal that letters and reports written by missionaries who lived in the Kalahari for many years were considered a dependable source of data.

For KwaZulu-Natal a consolidated ENSO African database with all the raw data collated for the region was supplied for the study. The database was developed by Nash *et al*. (2015) and Klein *et al*. (2016) to develop climate chronologies for KwaZulu-Natal during the 19th century. The database comprised of the following (Table 4-1) key information sources that were used for this study. The datasets were arranged according to their locations/archives and the type of collection. The abbreviated codes were used as a point of reference for when quoting direct statements from the data sources.

Table 4-1 : Primary sources of information used for KwaZulu-Natal during the 19th Century (Source: Nash *et al*., 2015)

Archival Location	Source Materials	Code
Bodleian Library at Rhodes House, University of Oxford, UK	Society for the Propagation of the Gospel materials for Natal and Zululand	USPG
British Library, London, UK	Various books and monographs, British Newspapers 1600-1950 (online), 19th Century British Newspapers (online)	
Council for World Mission archive, SOAS, London, UK	Wesleyan Methodist Missionary Society materials for Natal and Zululand	WMMS
Evangelisch-lutherisches Missionswerk Niedersachsen, Archiv, Hermannsburg, Germany	Hermannsburg Missionary Society materials for Natal and Zululand, including copies of the *Hermannsburger Missionsblatt* periodical	ELM
Houghton Library, Harvard University, USA	American Board of Commissioners for Foreign Missions papers for Natal and Zululand	ABCFM
Killie Campbell Africana Library, University of KwaZulu-Natal, Durban, South Africa	19th century diaries and other manuscripts, *Natal Witness* newspaper, Natal Blue Books plus other materials	KCAL
Msunduzi Municipal Library, Pietermaritzburg, South Africa	19th century materials, including *Natal Witness* newspaper, *Natal Almanac*, Natal Blue Books	
National Archives, London, UK	Various books, British Colonial Office materials	
Norwegian Mission Society archive, Stavanger, Norway	Norwegian Mission Society materials for Natal and Zululand	NMS

The data sources used for Lesotho (Table 4-2), were based on the work by Grab and Nash (2010) and Nash and Grab (2010). Similar to KwaZulu-Natal and the Kalahari, documentary evidence used, included letters, diaries, reports, monographs, newspaper records, articles written by missionaries and colonial representatives who lived and explored Lesotho and its surrounding landscapes (Grab and Nash, 2010; Nash and Grab, 2010). Data for the Kalahari and Lesotho is developed from unpublished collections, inclusive of primary British and French missionary materials (Nash and Adamson, 2014). Such data was a more thorough, comprehensive reconstruction (Nash and Adamson, 2014).

Table 4-2: Documentary sources of information used for Lesotho during the 19th century (Source: Nash and Grab, 2010: 476)

Archival Location	Name of Source	Code
School of Oriental and African Studies, University of London, UK (microfiche)	Unpublished letters written by missionaries working for the Paris Evangelical Missionary Society; code followed by AA (Afrique Australe series) or LES (Lesotho series) plus microfiche box number and microfiche number.	
School of Oriental and African Studies, University of London, UK (microfiche)	Unpublished Correspondence and Synod Minutes written by missionaries working for the Wesleyan Methodist Missionary Society; code followed by microfiche box number and microfiche number.	PEMS
Rhodes House Library, University of Oxford, UK	Unpublished materials written by missionaries working for the Society for the Propagation of the Gospel; code followed by D (for letters sent to the UK from Africa) or E (for annual reports by missionaries) and a volume number.	WMMS SA
Lesotho National Archive, Maseru, Lesotho	Annual Reports and Blue Books for Basutoland; plus official Diaries written by the Resident Commissioner; Incoming Letters from various districts; Outgoing Letters from government offices (all followed by archive catalogue number)	SPG
Rhodes House Library, University of Oxford, UK	Diaries written by Sir Godfrey Lagden, colonial government official, based in Maseru, Lesotho	LNA
Morija Museum and Archives, Morija, Lesotho	Various newspapers published in Lesotho, including *Leselinyana la Lesotho*, *Little Light of Basutoland* and *Litaba Tsa Lilemo*	GLD
Various locations	Books including annual colonial reports, Blue Books and parliamentary papers	Newspapers

For the Namaqualand region, the source materials that held valuable information included government reports, records and annual reports on the Namaqualand region which was useful for climate reconstruction (Kelso, 2010). Nash and Adamson (2014) revealed that the studies undertaken in Namaqualand drew heavily upon published monographs, reports and the colonial government “Blue Books”.

Kelso (2010) further pointed out that letters of the Civil Commissioner of Namaqualand, held at the Cape archives, were a useful source of information. A list of primary sources of materials that were relevant to the 19th century is listed as follows.

- Cape of Good Hope (Colony) Blue Books, Civil Commissioners Reports, 1838; 1857-1858; 1860; 1862-1865; 1867; 1869-1877; 1879-1881,
- Davies, H. and Shepherd, R.H.W., 1954: South African Missions 1800-1950: An Anthology, Thomas Nelson and Sons, London
- London Missionary Society (a), The Report of the Directors of the London Missionary Society, 1795-1814; 1815-1816; 1820-1842; 1844-1845; 1848; 1850-1856; 1905.
- London Missionary Society (b), Transactions of the London Missionary Society, 1806-1806; 1807-1812; 1814-1818; 1815-1819; 1820-1824; 1824-1828
- Wesleyan Methodist Missionary Society (a), *Methodist Magazine*, 1817-1827; 1829; 1832; 1837-1842; 1860.
- Wesleyan Methodist Missionary Society (b), *Reports of the Wesleyan Methodist Missionary Society,* 1818-1832; 1834-1836; 1838-1839; 1846-1847.
- Wesleyan Methodist Missionary Society (c), Missionary Notices, 1821-1822; 1826-1837; 1847; 1856-1859; 1864. (Source: Kelso, 2010).
- Wesleyan Methodist Church of South Africa, Reports of the South African Missionary Society, 1892-1893; 1926.

a) Unpublished Archival Sources Cape Archives

A list of unpublished source materials was provided by Kelso (2010) which was relevant to the 19th century Namaqualand (Table 4-3).

Table 4-3: List of archival sources for Namaqualand (Source: Kelso, 2010)

1/SBK 5/1/1.	Letter Book: Letters Dispatched by the Civil Commissioner of Namaqualand, 1856-1860
1/SBK 5/1/2.	Letter Book: Letters Dispatched by the Civil Commissioner of Namaqualand, 1861-1863
1/SBK 5/1/3	Letter Book: Letters Dispatched by the Civil Commissioner of Namaqualand, 1864-1866
1/SBK 5/1/4	Letter Book: Letters Dispatched by the Civil Commissioner of Namaqualand, 1867-1868
1/SBK 5/1/6	Letter Book: Letters Dispatched by the Civil Commissioner of Namaqualand, 1874-1878
1/SBK 5/1/7	Letter Book: Letters Dispatched by the Civil Commissioner of Namaqualand, 1878-1880
1/SBK 5/1/8	Letter Book: Letters Dispatched by the Civil Commissioner of Namaqualand, 1881-1884
1/SBK 5/1/9	Letter Book: Letters Dispatched by the Civil Commissioner of Namaqualand, 1885-1887
1/SBK 5/1/10	Letter Book: Letters Dispatched by the Civil Commissioner of Namaqualand, 1887-1891
1/SBK 5/1/11	Letter Book: Letters Dispatched by the Civil Commissioner of Namaqualand, 1891
1/SBK 5/1/12	Letter Book: Letters Dispatched by the Civil Commissioner of Namaqualand, 1892-1893
AGR 57	Letters re. Failure of Crops in Namaqualand, 1894-1895.
AGR 214	Locusts, Namaqualand, 1894

Data sources for the Karoo region relied upon source materials used by Lupini (2015) who developed climate chronologies for the region during the period 1840-1870. The data sources used for this study relied specifically on the Collet Diaries and the Cape Frontier Times.

Table 4-4: Documentary sources of information used for the Karoo during the 19th century

Type of Source Material	Source Details	Years Available
Diaries	Collet Diaries	1836, 1838-1875
Newspaper	Cape Frontier Times	1840-1864

The Cape Frontier Times, a local newspaper based in Grahamstown, reported regular news on the Albany and surrounding areas (Lupini, 2015). During periods of political instability and unrest, weather observations were seldom reported on, in order to shed news on the political state of the districts (Lupini, 2015). The Collett diaries used by Lupini (2015) were written by James Lydford Collett who was a successful farmer in areas such as Cradock and Albany. The diaries were rich in high resolution data and covered weather observations each month (Lupini, 2015). This is similar to that was argued by Norrgård (2013), who indicated that such sources of information provided rich descriptions of climate information.

4.1.2 Developing chronologies for climate impacts

The source materials were reviewed in detail and impacts were generated and grouped based on indicators and categories such as environmental changes/factors, social conditions, economic/livelihood impacts, pests and diseases, livestock conditions, crop conditions and human health. The relevant historical records contained a richness of information in their descriptions of the social and environmental circumstances during the period 1830-1900 (Naidoo, 2016). Such materials were read and analyzed with an aim to determine the effect of weather on society and the environment. The social and environmental aspects of this research are qualitative in nature, which is based on experiences and knowledge which was subjective in nature (Naidoo, 2016). Specific details were collected and recorded, which included economic volatility, social changes, commodities produced, livestock impacts and numbers, agriculture etc., following examples from Kelso (2010).

For each of the years, the impacts were compared to the climate chronologies that are available for the specific regions. In this way one can determine the impacts of specific climate events. In addition, regions were specifically colour coded to differentiate where impacts

happened. Societal impacts were thus easy to map across the various regions and differentiate the common periods when certain impacts occurred. This helped to determine how long certain impacts lasted in a specific region, and how soon a region could recover from certain impacts.

Data sorting produced a large volume of historical information which was related to all the factors in the broad categories and which had to be sorted in order to identify the dominant factors affecting societal impacts (Kelso, 2010). Adaptation and coping were recorded as separate from impacts and consequences. These responses were broken down into broad categories, some of which included but were not limited to things like traditional rainmaking, migration and population dispersal, and change in agro pastoral practices.

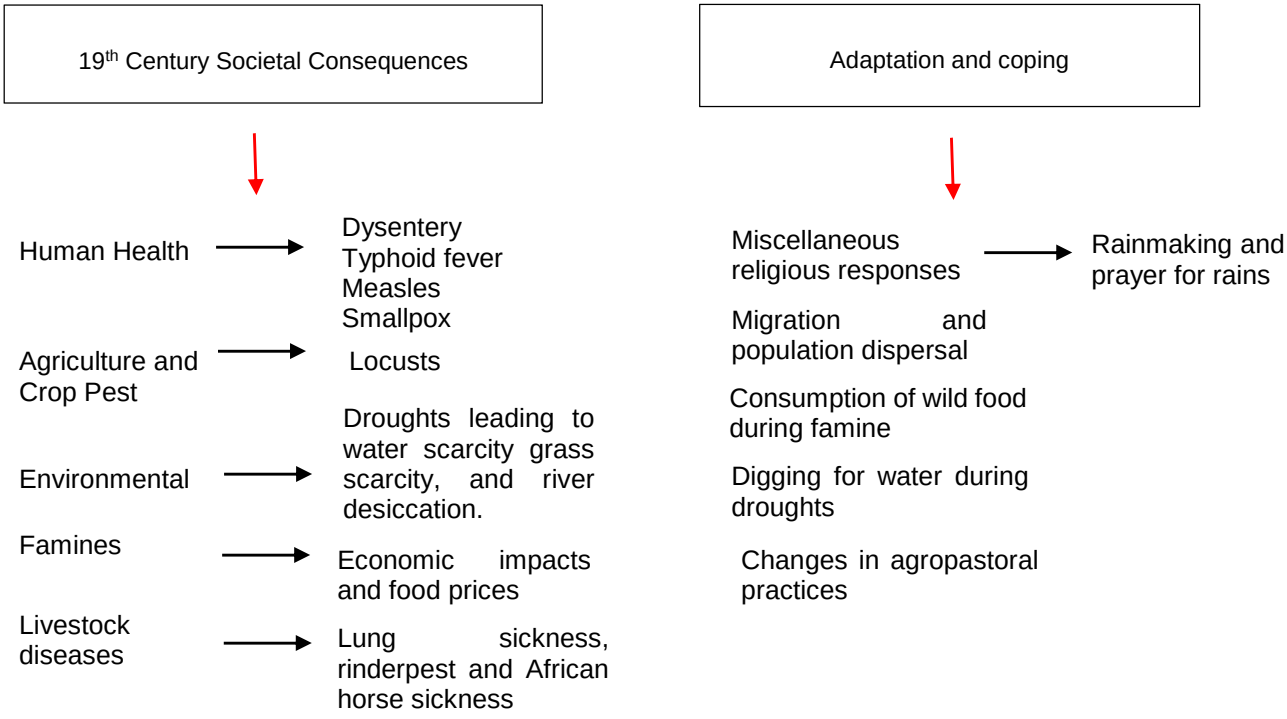


Figure 4-1: Categories for Broad Climate Impacts on Society and the Environment

Once all the information was recorded, a spatial comparative analysis helped address the research questions. This analysis looked at societal impacts and whether they occur during common periods in southern Africa. Further analysis discusses how long certain consequences lasted for and what the different recovery periods were between these consequences. The data drew conclusions to help separate and identify what coping and adaptation entailed during the 19th century. In addition, the environmental and societal consequences recorded were analyzed in relation to droughts and floods including ENSO (El Niño and La Niña) years that were already captured for the regions.

4.1.3 Frequency counts

A similar methodology used by Naidoo (2016) was adopted to analyze frequency counts of social and environmental consequences which occurred relatively, throughout the period 1830-1900 for southern Africa. This is also similar to what was adopted by Zheng *et al.* (2012) for southern China, which looked at the frequency counts of cold winter events during each half-century for the period 1650-2000. Frequency counts were useful to determine how often a specific impact was mentioned for a specific region which provides a good basis to determine how often an impact became widespread. For the social and environmental impacts which occurred frequently throughout the 19th century in southern Africa, exploring the frequency of such impacts provides an interesting representation of common occurrences within the different regions and where an impact was documented to be widespread. Such frequency counts have been conducted for most of the impacts in southern Africa as it has been found to be useful in leading to cautious meaningful interpretation of the data (Glaser, 1996).

4.1.4 Using direct quotes

The data analysis contains detailed descriptions which described certain events, or periods of distress, disease, health conditions or even responses. In order to enhance the discussions around impacts and consequences, direct quotes were used to portray certain events and impacts. Some quotations specifically for KwaZulu-Natal were written in German, Dutch and Norwegian by different missionaries so these were translated into English accordingly, however, the majority of the data had already been used by previous researchers and hence had already been translated. Direct quotes were used for the different indicators mentioned in *section 4.1.2* to describe the event in detail and those that lacked much detail were omitted (Naidoo, 2016). Quotes were recorded verbatim and no length was provided for the quotes, however quotes were chosen tactfully to ensure that there was specific information pertaining to social and environmental consequences and responses (Naidoo, 2016). In addition some of the quotations may not be grammatically correct, however no amendments were made to such quotations and they were therefore retained as per the original source.

4.1.5 Data limitations

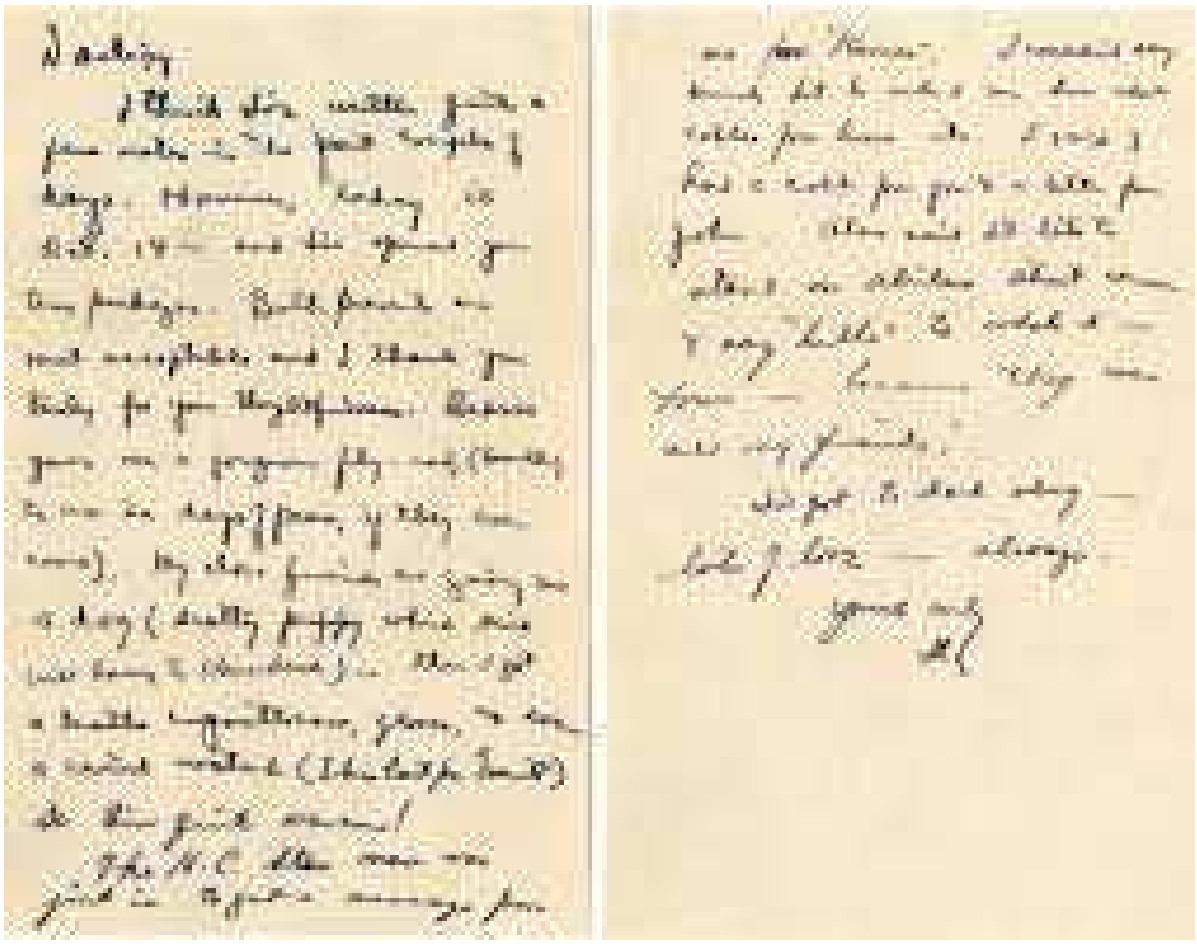
This study involved using data that had already been collected and used in previous historical projects. The specific data relating to social consequences was therefore not the primary objective of those previous historical projects which looked only at climate chronologies. Some of the data used for this study were therefore very limited and constrained in terms of their spatial coverage on social and environmental impacts per region. While some regions like KwaZulu-Natal had a richness of data, other regions like the Karoo for example were missing

data for some years towards the 1880s and1890s. Data sources for the Karoo region relied upon the Collett diaries, of which there were missing pages and illegible handwriting in some instances which affected the reliability of the data (Lupini, 2015). The years 1870-75 of the Collett diaries were also questioned in terms of their reliability due to Colletts' aging and health (Lupini, 2015). Due to this potential liability the years 1870-75 for this study are limited in terms of data for the Karoo region. Although the Collett Diaries proved to be a rich source of data for the Karoo, the years 1844-45, 1850-51 and 1861-62 were disrupted due to various factors affecting Collets' personal life such as political changes, war, tension and bankruptcy (Lupini, 2015).

4.1.6 Summary

The methodology presented in this chapter offers an overview of the approach undertaken for this research. Given that this research is based on existing historical projects already conducted by other researchers, the approach of this study is different compared to those projects. The methods used in this research will adopt a new and innovative approach to presenting social and environmental data to indicate the consequences of impacts. Although qualitative methods are applied in interpreting the data, the frequencies of such trends and impacts will be presented quantitatively to explore such impacts and conditions.

5 ANALYSIS OF RESULTS



5.1 Introduction

This chapter presents the comparative analysis of the results and findings of the societal impacts and consequences across southern African sub-regions. The first half of the chapter discusses the impacts and consequences that occurred during the 19th century, following a drought or flood event for the different sub-regions. Separate chronologies were constructed for the following themes:

- Human health impacts,
- Crop pests (Locusts),
- Social impacts- poverty,
- Environmental impacts-drought, and famine, and
- Livestock diseases.

The second half of this chapter discussed and unpacks the different coping and adaptation mechanisms that were adopted during the period, in response to the impacts and consequences. In this discussion, the argument on coping and adaptation will also try to answer the research question on whether it is possible to identify and separate coping and

adaptation mechanisms during the 19th century in southern Africa. In addition, the discussion on adaptation also looks into potential current adaptation in comparison to the historical context to determine if there were similarities between contemporary periods.

5.2 Human health impacts

This section highlights common diseases and epidemics affecting human health during the 19th century. The documented diseases, symptoms and the causes presented are rather vague from documentary sources. In some instances the diseases mentioned are described in terms of the influence of weather. Common diseases mentioned during the 19th century in southern Africa comprised of measles, smallpox, dysentery, unspecified diseases, influenza and colds, fevers and typhoid. It is also worth mentioning that some diseases were described, but it was not specifically mentioned what these diseases could be. However, they were described for the various regions in southern Africa. The epidemics of such communicable diseases mentioned in the 19th century have been a consequence of the contact between different cultures, communities, explorers, migration and colonization (Bashford, 2004).

5.2.1 Dysentery

Dysentery occurred in the Karoo during February of 1840 and February of 1844, both during relatively wet years, and in December of 1841, a year classified as very dry. Outbreaks in the Karoo are also common during summer months. During the 1844 outbreak, the impacts of dysentery in the Karoo reported deaths and were perceived to be, in part at least, due to weather, as described in the Cape Frontier Times:

"*Several privates … died of dysentery. There has also been much sickness amongst the community…the fierce heats that succeeded the excessive moisture occasioned by the late soaking rains having probably endangered a diseased state of the atmosphere*" (Cape Frontier Times, No 197 Vol. 4 22 February 1844).

Although it has not been mentioned in other areas during this period, it may have occurred in the intermediate areas. Fourteen years later during the 1860s, the disease spread to the Kalahari and KwaZulu-Natal regions and was documented to have taken place 7 times, indicating that perhaps there were more documented written reports about dysentery outbreaks in KwaZulu-Natal as compared to earlier times. The dysentery outbreak in the Kalahari during 1862 occurred amidst a widespread drought and famine during 1862, a year also classified as an El Niño year. While the dysentery outbreak reported in the year 1863 was in July and classified as a relatively wet year with food shortages described in KwaZulu-Natal, while the outbreak in 1865 occurred during February and was classified as a very dry/drought year, with famine. Despite the year 1863 being classified as relatively wet, the Natal Witness

(19 January 1863), published that the weather was changeable, however a long continued drought still affected the region, and a consequence of this was the scarce quantity of vegetables. However despite a food cart importing food into the region, the prices of such imports were quite high and unaffordable. The quote presented below further shows the descriptive language used to indicate such conditions:

Klip River, January 19, 1863. "With the exception of that ever-fruitful subject, the weather, I fear that this part of the colony has no news to communicate. During the past week we have had one or two thunder-showers, but not nearly enough for our wants. The long-continued drought that we have experienced has made vegetables scarce and dear. I saw a cart come into Ladysmith the other day bringing in onions and cabbages from a farm thirty miles off, and notwithstanding the high prices… they sold fast; in fact, women, children, and Kafirs might be seen rushing up the principal street to make sure of getting some of this green meat". (Natal Witness 19 January 1863)

This could suggest that famines were linked to some disease outbreaks, typically during droughts when resources are few and limited and communities remain more vulnerable to contracting such illnesses. Similar impacts reported in earlier years for the Karoo were faced in KwaZulu-Natal during 1863 with reported deaths occurring in Zulu kraals:

*"Tho' pestilence including dysentery has visited the country around us and in some kraals not far away many have died, yet our own health and that of the people on the station has been preserved and with the exception of one infant there have been no deaths during the year under review" (*ABC 15.4 Vol. 6, Reel 177. Mission to Zulu land 1860 -1871 Amahlongwa, Jul 28th 1863, Pixley).

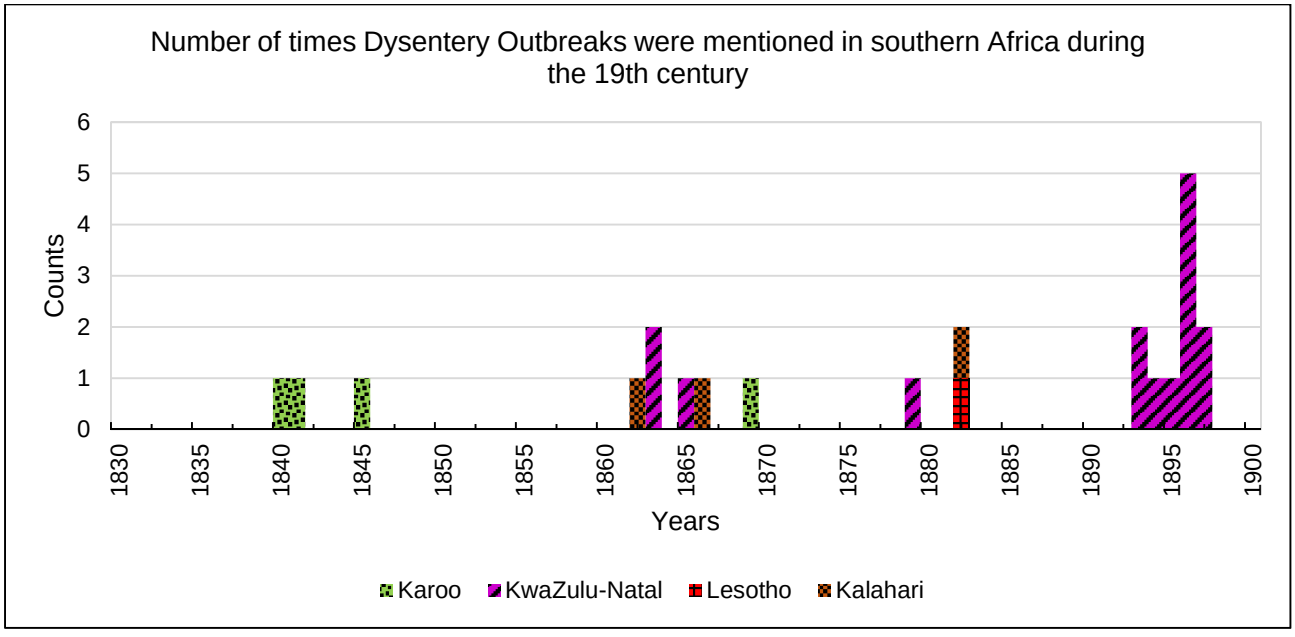


Figure 5-1: Number of times dysentery was reported for southern Africa during the 19th century

Dysentery outbreaks in the Kalahari, which were recorded to have taken place during relatively dry periods. Such observations were documented to have occurred in the Kalahari region in 1882 during periods of delayed summer rains as described below:

p. 158 "*The rains were delayed till November this year; and as a dry spring is here always an unhealthy one, the ravages of smallpox were succeeded by fever and dysentery*." (McKenzie, John (1883) Day-dawn in dark places: a story of wanderings and work in Bechwanaland. London: Cassell and Company).

Towards the end of the century, dysentery outbreaks were only documented to have taken place in KwaZulu-Natal while other regions remained clear of outbreaks. Widespread outbreaks occurred from 1893 -1897. The year 1893 was classified as a very wet year with floods, 1894 was classified as having seasonal rains, 1895-96 classified as a very dry/drought period, and 1897 was a relatively dry year. Such observations could imply that since the disease happens in both very wet and dry years that climate may not necessarily be the driver of such outbreaks. A general comment made in this regard implies that excessive rain and exposure has brought about much sickness, including deaths. This implies that the outbreaks of dysentery may not necessarily have a strong connection between extremes of drought and wet periods and that it occurred during both dry and wet years:

Amanzimtote, report for year ending June 1894, 1893-94
"Owing possibly to the excessive rain and consequent exposure, it has been a year abounding in sickness and death. In a single Kraal there were a dozen deaths. Many station children have died. The prevailing sickness (prevailing over So. Africa indeed) dysentery, has revealed the superstitious spirit of the people. Even church members have been afraid to go near their sick relatives. It is interesting to note that coffins are now in demand among the outside people and these heathen have even purchased lots in the cemetery".(Harvard, Houghton Library, ABC 15.4, vol. 13, Southern Africa, Zulu Mission 1890-99 ABC 15.4. vol. 13 (A 467, 188, 40)

Other documentary evidence indicating that dysentery may not only be climate related was recorded in a statement by Cowles (1894) (*Harvard, Houghton Library, ABC 15.4. vol. 13 (A 467, 188, 53), Southern Africa, Zulu Mission 1890-99).* During the latter part of 1894 in KwaZulu-Natal, outbreaks of dysentery were taking place in schools and affected a number of school boys. While missionaries described that serious care was required to curb the severe dysentery cases, the cause of the outbreaks were not associated with climate but rather consumption of river water described as follows:

Cowles, G.B., Adams school at Amanzimtoti, report June 1895, 1894-95
"The health of both teachers and pupils has been good this term; but in the latter half of the previous term, there was an epidemic of dysentery, among the boys. Half or two-thirds were ill and a number of very serious cases developed requiring careful attention and special food. [...] We think that the trouble arose from drinking river-water". (Harvard, Houghton Library, ABC 15.4. vol. 13 (A 467, 188, 53), Southern Africa, Zulu Mission 1890-99)

However, the spike in dysentery outbreaks during the 1896 outbreaks could have been as a result of that specific year being classified as having a widespread drought and impacted on river water quality, which could have worsened the outbreaks of dysentery in the region. In addition, the years 1894-1897 were reported as famine years in KwaZulu-Natal (Natal Witness 15 January 1894, USPG D110, C. Johnson, St Augustine's, Rorke's Drift, 10 August 1894, USPG E50d, S.M. Samuelson, St Paul's, Zululand, 30 June 1895, Missionsblatt 43/6, Hermannsburg 1896, 58-61USPG E51b, S.M. Samuelson, Polela, 31 March 1896, Natal Witness 31 December 1896,Missionsblatt 44/9,Hermannsburg 1897, 226), with 1893 being a year in which KwaZulu-Natal suffered a water crisis with severe water shortages. During a year of seasonal rains in 1894 in KwaZulu-Natal, there was a massive outbreak of dysentery affecting local schools and consequently this resulted in the closure of schools in the region. This could be seen as a preventative measure or coping mechanism to avoid further spread of the disease. This is further reported by the report of the Zulu mission as follows:

Report of the Zulu Mission 1895-96 Ifafa: "*The day school (Ifafa or outstation Dumisa) closed for some weeks owing to an epidemic of dysentery*". (ABC 15.4. vol. 13 (A 467, 188, 62)

Further remarks on dysentery have been made in KwaZulu-Natal in 1882 by missionary correspondent - Lindley. The correspondent described the disease as having frightful rates of mortality amongst missionary families in KwaZulu-Natal (ABC 15.4 vol. 6, Reel 177. Mission to Zulu land 1860-1871 Manda, Port Natal, 8 February 1865). Local indigenous people believed that native doctors can provide a cure for the disease, although missionaries contested such thoughts and find this to be superstitious behaviour, as described below:

For the last month there has been a great deal of sickness in the country. Many have died. The disease has its seat in the bowels and in a large majority of cases manifests itself as dysentery. In some localities the mortality has been frightful. Up to this time so far as I now know our mission families have wholly escaped the attack of the destroyer. It makes my heart ache to see how the stupid native doctor are keeping on the work of destruction. O! The miseries of ignorant, suspicious and superstitious heathenism. The prevailing sickness has attacked quite a number on my station but has caused no deaths. This, under God I ascribe

to the fact that my people take our medicines and have nothing to do with the native doctors (ABC 15.4 vol. 6, Reel 177. Mission to Zulu land 1860-1871 Manda, Port Natal, 8th February 1865).

According to literature, the outbreaks of dysentery in southern Africa were caused mainly in standing camps, which were often overcrowded and displayed poor sanitation and water supplies (Laing, 1906). However, the disease is observed to be most prevalent in summer, during the rainy season (Laing, 1906). According to the findings of this study, it links to the literature by Laing (1906) as such cases of outbreaks taking place in camps were recorded in Lesotho during February 1882:

"*I have still to report that the past quarter has been mainly a time of waiting… Our population is as large as ever, most of the loyals being still in camp on the heights. Owing to the crowded state of the camps, fever and dysentery have been very prevalent during the hot summer months… We are hoping that with the approach of winter this sickness may disappear*." (SPG E37 (1882) Report of Rev. J. Widdicombe, Thlotse Heights, for the quarter ending 28 February 1882).

Although the mining camps were not responsible for the outbreak of the disease in other regions, this does not mean that these regions did not have mining areas or such camps.

5.2.2 Smallpox

Smallpox was documented 10 times throughout the 19th century and impacts were documented in the Karoo, KwaZulu-Natal and Kalahari regions (Figure 5-2).

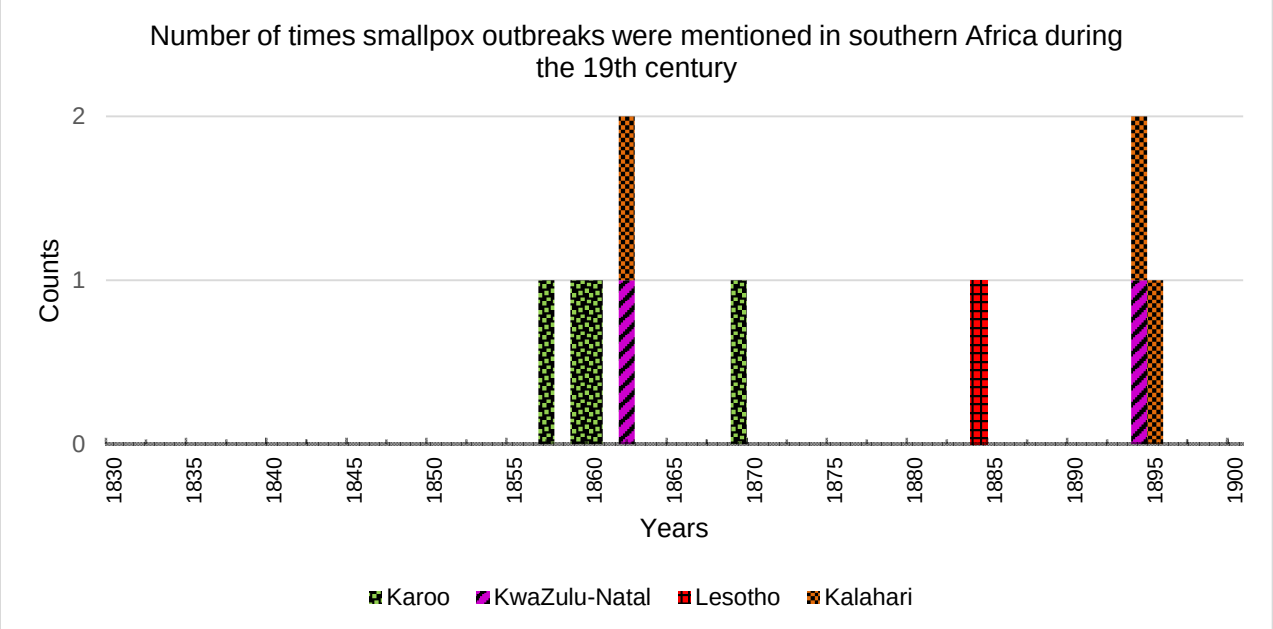


Figure 5-2: Number of times smallpox was reported for southern Africa during the 19th century

Smallpox was documented to have started in the year 1857 and continued into 1860 in the Karoo region. Of these documented years, 1857 was classified as a normal year, while 1859-60 was a relatively dry period. During the 1859 outbreaks in the Karoo, smallpox created a period of hardship amongst the indigenous people (Cape of Good Hope (Colony) Blue Books, 1859 p.JJ 16-17: Year of 1859 *Appendix: Colesberg*). This period of hardship may be related to the fact that indigenous people had not experienced diseases of this kind before, and trying to overcome them was difficult, particularly given that 1859 was already a drought year when people had fewer resources and were trying to overcome the challenges associated with drought, which made them more vulnerable to smallpox. Smallpox was therefore a disease which also caused much suffering, especially with those indigenous people who may have had a lower resistance to the disease due to hunger and droughts. Such droughts also caused much scarcity and suffering in the region, which is further reported in the Cape Colony Blue Books as follows:

"*The past year has been one of severe drought in the division. This and the appearance of small-pox in the town and in several parts of the country has caused great scarcity to all and hardships to many*." (Cape of Good Hope (Colony) Blue Books, 1859 p.JJ 16-17: Year of 1859 *Appendix: Colesberg*).

By 1860, although smallpox made its appearance in the Karoo region, documentary evidence suggested that the disease was well controlled through precautionary measures taken to ensure that it did not spread further. This has been reported in the Cape of Good Hope (Colony) Blue Books as follows:

"The small-pox has fortunately not visited this village and only one farm did it make its appearance, but through proper care and precaution it did not spread further." (Cape of Good Hope (Colony) Blue Books, 1859 p.JJ 25: Year of 1860 *Appendix: Middelburg*).

There is no mention of small-pox until 1862 when it appeared in both KwaZulu-Natal and the Kalahari regions during periods of drought. The drought of 1862 in the Kalahari also coincided with an El Niño event of moderate strength (Nash and Endfield, 2002).Since droughts were quite widespread in these years, the occurrence of small-pox outbreaks could have exacerbated with such droughts. Droughts may have also been linked to poor resource settings which posed greater disadvantages when it came to coping with such diseases like small-pox.

Smallpox was not documented to have appeared in the Kalahari and KwaZulu-Natal until three decades later, toward the end of the century during 1894-95. This could be attributed to mitigation measures in the form of vaccinations that were already introduced in 1863 in KwaZulu-Natal, just after the 1862 outbreaks, which controlled the further spread of the disease (Callaway, 1863 USPG D25a, H.Callaway, Spring Vale, 30 June 1863). While smallpox outbreaks recorded in the year 1894 in KwaZulu-Natal coincided with seasonal rains, the Kalahari experienced a drought during the outbreak in 1894-95. The year 1895 was also described as an intense dry phase in the Kalahari region (Nash and Endfield, 2002), during which smallpox appeared. Both outbreaks in the Kalahari were during summer months. This supports the findings of Nishiura and Kashiwagi (2008), who established that smallpox is seasonal and enhanced by dry weather.

By 1862-63, the missionaries in KwaZulu-Natal were introducing smallpox vaccinations amongst indigenous people with more than 400 vaccinations done as mitigation measures in order to prevent further outbreaks (Callaway, 1863 USPG D25a, H.Callaway, Spring Vale, 30 June 1863). By the 1894 outbreak, quarantine measures were adopted in Zululand to control and prevent the disease from spreading across kraals. Such measures are further described below by missionary H.T.A Thompson (1894):

"*In the past three or four months, the people had been left without a teacher, as the catechist working among them then lived in Zululand, and the Zulus were all under quarantine on account of smallpox having broken out in their two kraals. Fortunately on Saturday the quarantine was raised and we were enabled to cross the Buffalo River to Mr Johnson's a few miles the other side*" (USPG E49c, H.T.A. Thompson, Inhlonhlweni, Ladysmith, 31 December 1894).

Such preventative measures could also be a reason why other regions may not have been affected during this period, however the outbreak in 1884 in Lesotho was a result of the diamond fields and spread between workers in these fields (SPG E39b (Report of Rev. E. Stenson, Mafeteng, for the quarter ending 31 December 1884). Basotho chiefs were beginning to adopt strict control methods to prevent the disease from spreading further. Conditions in the diamond mines were described as being inhuman, with workers being confined to such poor living quarters which enabled unhygienic conditions that exacerbated such diseases (Thompson, 2001).

"*The year has been one of great want and suffering. Smallpox imported from the Diamond Fields at one time threatened to decimate the people – terribly stringent measures for the isolation of the infected were adopted by the chiefs – whole villages being 'tabooed' – and the*

disease died out in some cases with the last inhabitant "(SPG E39b (1884) Report of Rev. E. Stenson, Mafeteng, for the quarter ending 31 December 1884).

5.2.3 Measles

Measles was not very common and was mentioned a total of nine times from Namaqualand, the Karoo and KwaZulu-Natal (Figure 5-3). The earliest mention of the disease was in 1839 in both Lesotho and Namaqualand. The year 1839 was a drought year in Namaqualand during the measles outbreaks, while Lesotho was classified as having normal rains. The documented outbreak for Lesotho was recorded during September. However in Namaqualand, what stands out is that this year was classified as a severe drought period coinciding to an El Niño event (Kelso, 2010). The following year (1840) and in 1841, measles appeared in the Karoo during relatively wet periods in summer (Cape Frontier Times No1 Vol1 1 January 1840, Cape Frontier Times No 75 Vol. 2, 7 October 1841).

Nine years later (1851), measles made its appearance again in the Karoo region, during a normal rainfall year, and again during 1860-61, also classified as a 'normal years' (Cape of Good Hope (Colony) Blue Books. Cape Town, Richards. P.JJ 27: Year of 1860 *Appendix Uitenhage*, Cape of Good Hope (Colony) Blue Books. Cape Town, Richards. P.JJ 27: Year of 1861 *Appendix Burgersdorp*). The outbreaks of measles documented in the Karoo during 1860 was not a fatal occurrence of the disease, with only a few cases of epidemics reported in Uitenhage which is described by the Cape of Good Hope (Colony) Blue Books:

"*The prevailing diseases during the past year have been measles among children, simple continuous fever among adults and occasional bronchitis, but upon the whole, the year may be considered as having been tolerably healthy. The most general complaint, measles, appeared chiefly in mild form, and with very few fatal results*."(Cape of Good Hope (Colony) Blue Books. Cape Town, Richards. P.JJ 27: Year of 1860 *Appendix Uitenhage).*

Thirty years later (1892), measles was documented to have spread into KwaZulu-Natal with no mention of it happening in other areas during this period (USPG E47b, S.M. Samuelson, St Paul's, Zululand, 31 March 1892). The outbreak in 1892 coincided with a very wet/flood year during the summer season in January, while the outbreak during 1895 was during a very dry/drought year also during the summer of October in KwaZulu-Natal. The literature by Ferrinho (1993) confirms that throughout the African continent, the peak of measles occurs in both dry and wet seasons, which is in agreement with the findings of this research.

The documented impacts of measles in 1892 in KwaZulu-Natal mentioned outbreaks affecting children (USPG E47b, S.M. Samuelson, St Paul's, Zululand, 31 March 1892). The possibility

could be that outbreaks happening in schools, thus making children more vulnerable to measles. The same impacts were reported for the Karoo region in 1860, which also documented outbreaks amongst children, as described in the quotation below:

"*The prevailing diseases during the past year have been measles among children, simple continuous fevers among adults and occasional cases of bronchitis, but upon the whole, the year may be considered as having been tolerably healthy. The most general complaint, measles, appeared chiefly in mild form, and with very few fatal results*…" (Cape of Good Hope (Colony) Blue Books, Cape Town, Richards. P.JJ 10-11 Year of 1860 *Appendix: Beaufort*).

Missionary correspondence in Lesotho confirms that measles outbreaks impacted both local wagon boys and missionaries; this could be attributed to the fact that they had greater contact with being exposed to the outbreaks from having to transport people.

"*On the sixth of April we arrived at the Fish River but the river being full we were obliged to wait for several days before we could cross it. Then describes a major outbreak of measles amongst the missionaries and waggon boys and notes that the weather was exceptionally cold"* (WMMS SA CORRESPONDENCE FBN4 Mf 116. W. Garner, Lishuani, 14 September 1839).

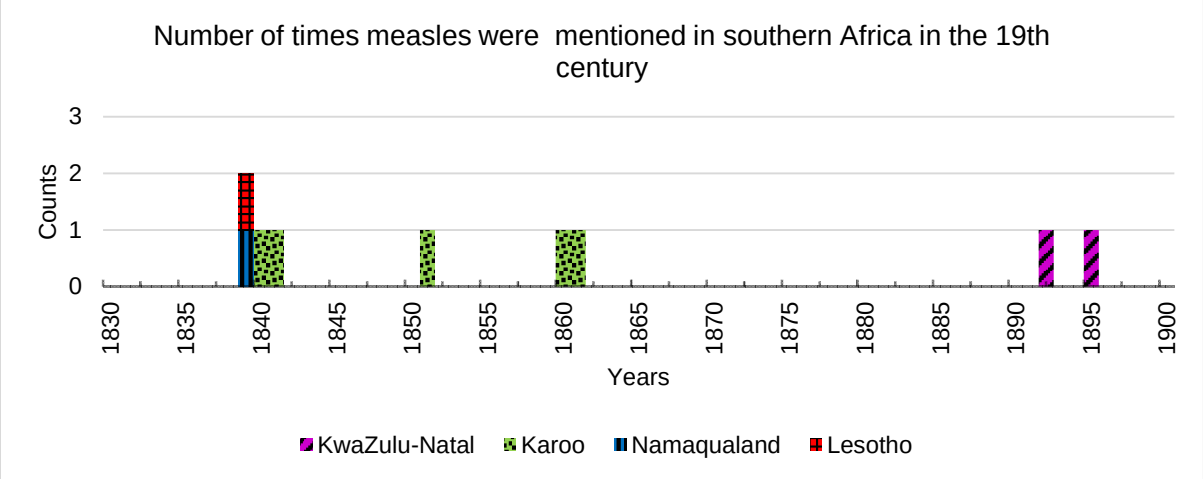


Figure 5-3: Number of times measles was reported for southern Africa during the 19th century

5.2.4 Typhoid

Typhoid fever was mentioned a total of seven times in Lesotho, Namaqualand and KwaZulu-Natal regions. Literature by van Heyningen (2010) suggested that typhoid was identified in 1890 in southern Africa, however from the documentary evidence, typhoid was mentioned as early as 1859 in Lesotho (Germond, R.C. (1967) Chronicles of Basutoland: a running commentary on the events of the years 1830-1902 by the French protestant missionaries in

Southern Africa. Morija Sesuto Book Depot, Morija, Lesotho (citing Jousse, Thaba Bosiu, May 1859).

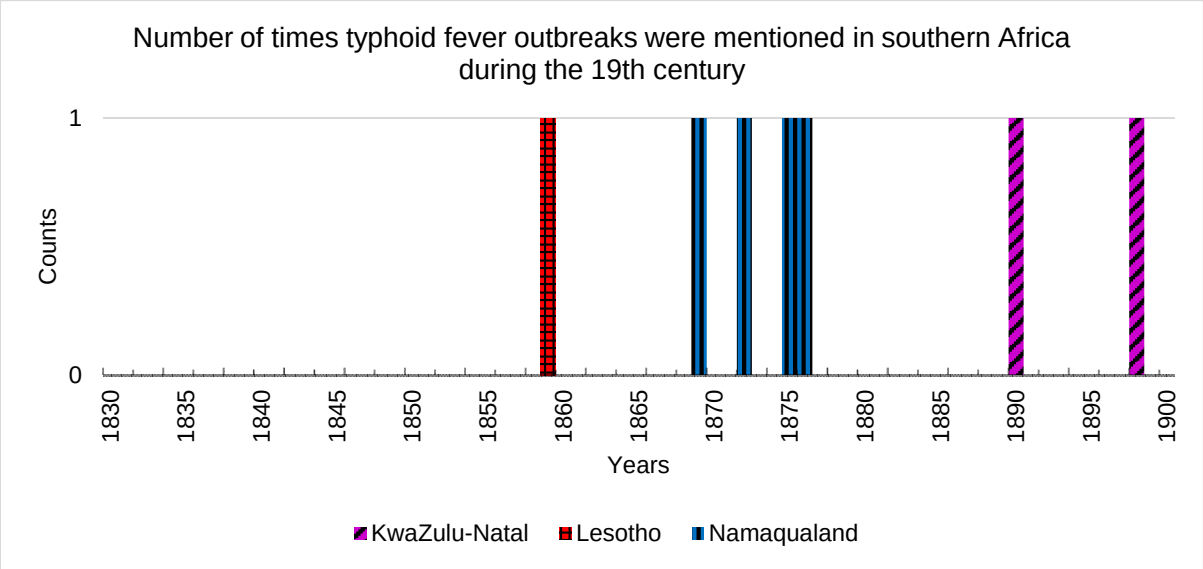


Figure 5-4: Number of times typhoid fever was reported for southern Africa during the 19th century

Typhoid fever outbreaks in Namaqualand took place in normal (1869) (The Cape of Good Hope (Colony), Blue Books Civil Commissioner's Reports 1838-1881) dry (1876) (Civil Commissioner's Report, 1876), drought (1875) (Civil Commissioner's Report, 1875) and wet years (1872). In KwaZulu-Natal, the disease was documented twice, once in the year 1898 (a relatively dry year) (Harvard, Houghton Library, ABC 15.6.2, vol. 2., Zulu, East Africa, Woman's Board of Missions 1886-1899) and once in 1890 (a dry period) (Harvard, Houghton Library, ABC 15.6.2, vol. 2., Zulu, East Africa, Woman's Board of Missions 1886-1899). In Lesotho the disease was mentioned once in the year 1859 (classified as a normal year) (Germond, R.C. (1967) Chronicles of Basutoland: a running commentary on the events of the years 1830-1902 by the French protestant missionaries in Southern Africa. Morija Sesuto Book Depot, Morija, Lesotho (Citing Jousse, Thaba Bosiu, May 1859)). During the year 1859, Lesotho was experiencing a prolonged drought and famine, while the outbreaks of typhoid fever in KwaZulu-Natal were also during famine and a period of water scarcity in 1890. Such occurrences of famine during typhoid fever outbreaks suggests that famine increases the risk of contracting diseases due to decreased access to food and water during droughts. Such links between famine, droughts and typhoid fever have been documented in Lesotho as follows:

p.456 "*This year has been fertile in trials of every kind; a war, prolonged drought, famine, typhoid fever, such are the divine chastisements that have passed over our heads one after*

the other." (Citing Jousse, Thaba Bosiu, May 1859) (Germond, R.C. (1967) Chronicles of Basutoland: a running commentary on the events of the years 1830-1902 by the French protestant missionaries in Southern Africa. Morija Sesuto Book Depot, Morija, Lesotho)

The year 1875 was a classified drought year and 1876 was a classified dry year during which typhoid fever appeared in Namaqualand (Civil Commissioner's Report, 1875; Civil Commissioner's Report, 1876). During both of these years, the region was also experiencing severe water scarcity (Civil Commissioners Report, 1875; Civil Commissioners Report 1876). This supports the literature by Parry (2005) who identified that typhoid may be conveyed during periods when access to water remains inadequate; suggesting that water scarcity may have further worsened the typhoid outbreaks in Namaqualand during the drought. The documented records for Namaqualand also indicate that the prevalence of the disease was rife during summer months, and in some instances recorded deaths were documented in Namaqualand in 1875-76, this has been illustrated below:

"*Typhoid fever has been very prevalent and the mine, and has carried off a great many, both whites and blacks. And this appears to be the case every summer*" (Civil Commissioner's Report, 1875).

While the year 1875, a drought year (Kelso, 2010) highlights that there were a great number of deaths amongst indigenous people, compared to 1876, a dry year (Kelso, 2010) fewer deaths were reported in 1876, which may indicate that Namaqualand was recovering from typhoid fever. Although there is not enough evidence that states the climate was better in 1875 than 1876, it could mean that since 1875 was classified as a dry year, the availability of resources improved during that year and the ability of Namaqualand to recover from typhoid was better in 1876 than 1875, which was classified as a severe drought year.

"Typhoid fever seems to be becoming an annual epidemic; there have been a good many cases, but fewer deaths than in the previous year" (Civil Commissioner's Report, 1876).

The impacts of typhoid fever recorded in KwaZulu-Natal differ from those reported in Namaqualand, as typhoid fever was caused through contact with polluted river water. This supports the findings by Akullian *et al*. (2015) who indicate that environmental factors such as contaminated water bodies may exacerbate the outbreak of typhoid fever. This is highlighted in a letter by Laura Smith Adams (1898) for KwaZulu-Natal:

"But the serious sickness was by no means past, and this scarcely a break someone was requiring unremitting care till the end of the term. The last six weeks or more it was Mrs Malcolm's little girl Frances, will head typhoid fever. We could find no cause for the sickness

in the building or grounds,[...]. The only cause which we can assign was that the water of the river must have been infected by the rinderpest which has swept through the land". (Harvard, Houghton Library, ABC 15.6.2, vol. 2. Zulu, East Africa, Woman's Board of Missions 1886-1899 ABC WBM 15.6.2. vol. 2 A 467, 221, 128).

5.3 Crop pests

Locusts were the major, prevalent crop pest during the 19th century which had an impact on agriculture and livelihoods. The majority (47%) of locust outbreaks were documented for the KwaZulu-Natal region during the 19th century, equating to a total count of 190, while 18% (73 counts) of locust outbreaks were documented in Lesotho, followed by the Karoo (28%) having a total documented count of 116, the Kalahari (5%) displaying 21 counts and Namaqualand displaying the least mentions (2%) of locusts, having a documented total count of 7 (

Figure 5-5).

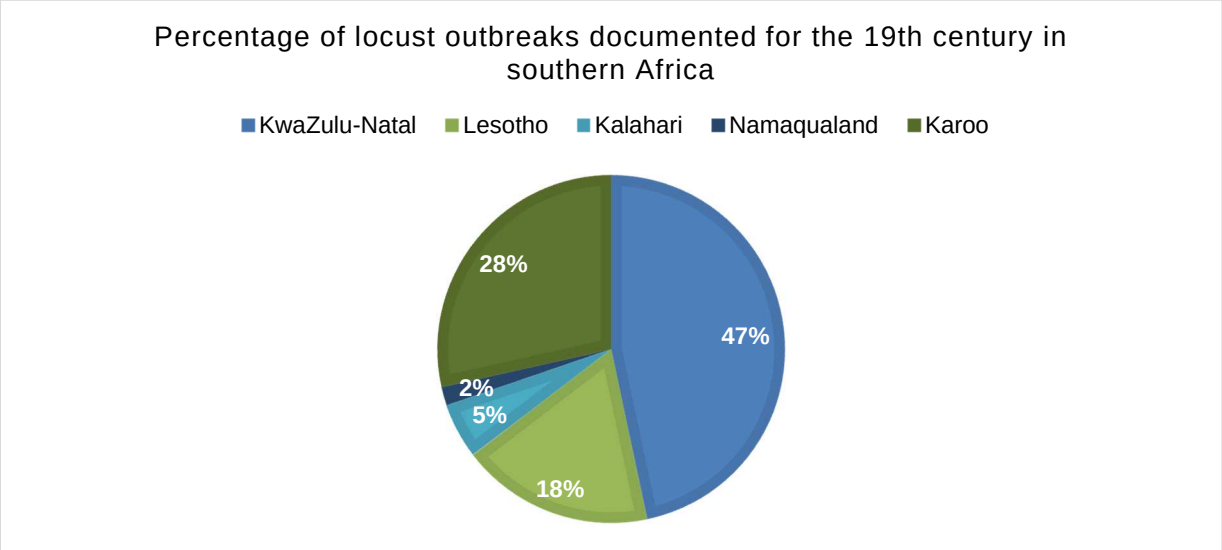


Figure 5-5: Percentage distribution of documented locust outbreaks across southern Africa in the 19th century

Documented outbreaks of locusts were mentioned four times in the early 1830s, with outbreaks documented once each for the Karoo in 1832, KwaZulu-Natal in 1837 (ABC Film 467 Volume 2, George Champion's journal) and Namaqualand and the Kalahari both having outbreaks in 1836 (LMS C 15-2-D R. Edwards Kuruman 18 July 1836). The outbreaks documented for the Kalahari and KwaZulu-Natal were both during the winter months of July and August respectively, although the year 1836 in the Kalahari was an unclassified rainfall year due to missing data (Nash and Endfield, 2002), and in KwaZulu-Natal the year was classified as a very dry/drought year (Klein *et al*., 2016) (Table 5-2 to Table 5-6). Although

locusts were documented as early as 1832 in the Karoo, they were particularly devastating to crops during the 1840s, as highlighted in documentary comments (see Table 5-1):

Table 5-1: Documented references made to crop destructions as a result of locust outbreaks in southern AfricaRegion

	Quotation	Reference
Karoo (1841)	"the locusts are still very troublesome in the neighbourhood of Grahamstown…. Visited Table Farm as well as Saxfold, and destroyed the gardens on both estates".	Cape Frontier Times No 66 Vol. 6, 4 August 1841
Karoo (1842)	"We have heard that a large swarm of young locusts hatched in Oliphants Hoek, after doing much mischief on a farm at the Kareiga, have lately winged their flight towards the Kowie"	Cape Frontier Times No124 Vol. 3, 15 September 1842
Karoo (1843)	"locusts committing their ravages… upon gardens in Grahams Town.. also appeared in the districts of George and Swellendam… From Somerset… myriads of locusts here".	Cape Frontier Times No 144 Vol. 3, 2 February 1843
Karoo (1844)	"Locusts – we have this morning spoken to several Dutch farmers, who describe the whole of the country along the little and great fish rivers as swarming with myriads of locusts and the vegetation on many of the farms as being entirely destroyed"	Cape Frontier Times No 206 Vol. 4, 25 April 1844
Namaqualand (1841)	"Missionary meeting. One man thanked God for preserving his corn from the locusts while the fields of the neighbouring farmers were destroyed, and they suffered want of bread. Although a poor man, he subscribed a sovereign".	Tindall: B.A, 1959: The Journal of Joseph Tindall: Missionary in South West Africa 1839-1855, The Van Riebeeck Society, Cape Town.- 26 August 1841
Namaqualand (1842)	"After several years of drought, we had, in the early part of 1826, been pleased with plentiful rains, and the earth was speedily covered with verdure; but our hopes of abundance were soon cut off by swarms of locusts, which infested every part of the country, devouring every species of vegetation".	Wesleyan-Methodist Magazine, 1842, 594

During the year 1836, devastating locust outbreaks damaged crops and garden produce in the Kalahari region (LMS C 15-2-D R. Edwards Kuruman 18 July 1836). The effects of a long continued drought in the region further exacerbated locust outbreaks, and consequently major destruction to crops have been reported and described:

"*It must be observed this country owing to the long continued drought is impoverished and the people lead a hungry thirsty life… locusts which are a great destruction to crops and the produce of gardens*". (LMS C 15-2-D R. Edwards Kuruman 18 July 1836).

Similarly, for the Karoo region, the unclassified years during 1832 and 1836 were documented to have locust outbreaks take place during summer. As the 1840s appear, there are more documented cases of locust outbreaks in southern Africa (Figure 5-6). During the first half of

the 1840s, the majority of the outbreaks (a total of 30 mentioned counts) were documented for the Karoo region, with eight of these outbreaks happening in spring/summer months over normal rainfall years (Collett Diaries, no date, February 1843, Collett Diaries, 9 February 1843, Collett Diaries, no date, October 1843, Collett Diaries 2 October 1843, Collett Diaries 1 December 1843, Collett Diaries 6 December 1843, Collett Diaries 12 December 1843, Collett Diaries no date, January 1844). The outbreak a year later for the Karoo occurred during the autumn months of April and May and winter months of June and August, followed by autumn/winter rainfall recorded in April, May, June and July (Collett Diaries 27 April 1841, Collett Diaries 30 April 1841, Collett Diaries 24 May 1841, Collett Diaries 27 May 1841, Collett Diaries, no date, June 1841, Collett Diaries 27 July 1841) with good pasturage conditions and abundant harvests during winter (Collett Diaries, 11 June 1841). Such records of abundant harvests created favourable conditions for locust outbreaks. These findings are also consistent with that by Cressman (2013), who established that locust outbreaks are favourable during rainy and wet conditions. In addition, Cressman (2013) argued that weather conditions play a role in the behavioural patterns of locusts, emphasizing that widespread outbreaks of locust plagues are usually after rainfall. The outbreaks in the Karoo that took place during 1845 were during relatively wet periods in October and November, while 1847 was a year in which the Karoo was very wet with floods and the timing of locusts during this year were widespread during the end of winter into early spring months (September and October) (Collet Diaries 15 November 1845, Cape Frontier Times no 285 Vol. 6 30 November 1845, Cape Frontier Times, No377 Vol. 8 3 August 1847, Cape Frontier Times No382 Vol8 14 September 1847, Cape Frontier Times, No 386 Vol8 12 October 1847).

The documented evidence illustrates the fact that outbreaks, in the Kalahari region in 1843, occurred during a very dry/drought winter month of June (LMS DL Box 1 D. Livingstone Kuruman 24 June 1843). Although the year 1842 did not document locusts for the Kalahari region, evidence for 1843 indicated that it did take place prior to 1843 as missionaries described quantified swarms of locusts taking place for a period of 12 months:

"*During a period of twelve months, I saw no fewer than nineteen swarms of locusts and yet no particular damage was done to the crops of the indigenous people in consequence*" (LMS DL Box 1 D. Livingstone Kuruman 24 June 1843).

During the year 1843, documented outbreaks for Lesotho were during a relatively wet period towards the end of spring (WMMS SA CORRESPONDENCE FBN4 Mf 123. R. Giddy, Thaba Nchu, 25 November 1843). Compared to 1841-43 in Namaqualand, all outbreaks were documented in early autumn during March (Tindall, 1959, 50, Wesleyan-Methodist Magazine, 1842, 594). These years were all unclassified due to insufficient evidence (Kelso, 2010).

Although documented evidence indicates that during the year 1842, Namaqualand experienced plentiful rains with abundant harvests, these were favourable conditions for locust outbreaks, with documented evidence highlighting that crops were ravaged and vegetation was demolished (Wesleyan-Methodist Magazine, 1842, 594). A detailed report of this is given further in the extract below:

"*After several years of drought, we had, in the early part of 1826, been pleased with plentiful rains, and the earth was speedily covered with verdure; but our hopes of abundance were soon cut off by swarms of locusts, which infested every part of the country, devouring every species of vegetation. They had not been seen for more than twenty years before, but have never entirely left the country since. They might be seen passing over like an immense cloud, extending from the earth to a considerable height; producing with their wings, a great noise. They always proceed nearly in the direction of the wind, those in advance descending to eat anything they light upon, and rising in the rear, as the cloud advances*".(Wesleyan-Methodist Magazine, 1842, 594).

As a societal response to locust outbreaks in Lesotho during 1843, indigenous people were consulting a female fortune teller as a means of dealing with locusts. Local indigenous people were trying to obtain possible means of prevention of locusts, which is recorded in the following correspondence:

"Discussing a female fortune teller in the village: "The locusts having come in such swarms this year as to threaten the destruction of all the corn in the land she was consulted as to the best means if preventing if possible such an occurrence." (WMMS SA CORRESPONDENCE FBN4 Mf 123. R. Giddy, Thaba Nchu, 25 November 1843).

Outbreaks for the 1850s showed that locusts were documented 26 times across all regions, with 21 documented cases being in the Karoo during this period, indicating that it was documented to be more widespread in the Karoo than other regions. The outbreaks in the 1850s lasted for six consecutive years from 1850-1856, with the Karoo region documented to be affected in all of these years. In four of these years (1850-52 and 1854), the Karoo was classified as relatively dry (Lupini, 2015) and outbreaks documented during these years were mainly occurring during spring/summer (Cape Frontier Times No 505 Vol. 10, 29 January 1850, Cape Frontier Times No 509 Vol10 26 February 1850, Cape Frontier Times No 548 Vol10, 26 November 1850, Cape Frontier Times, No 554 Vol10, 7 January 1851, Cape Frontier Times, No 623 Vol12, 4 May 1852, Cape Frontier Times, No 655 Vol. 12, 21 December 1852, Cape Frontier Times, No 718 Vol16, 14 March 1854).

Locusts were mentioned once in 1850 in Lesotho, during a relatively dry period in February (Germond, R.C. (1967) Chronicles of Basutoland: a running commentary on the events of the years 1830-1902 by the French protestant missionaries in Southern Africa. Morija Sesuto Book Depot, Morija, Lesotho, citing Lauga, Carmel, February 1850). Coupled with droughts, Lesotho was also faced with harvest shortages and plagues of locusts during this period, as further described below:

p.448 "I had set considerable store on this year's harvest; but because of the drought and the quantity of locusts which we have had, it is far from fulfilling our expectations." (citing Lauga, Carmel, February 1850). (Germond, R.C. (1967) Chronicles of Basutoland: a running commentary on the events of the years 1830-1902 by the French protestant missionaries in Southern Africa. Morija Sesuto Book Depot, Morija, Lesotho).

The timing of locusts in KwaZulu-Natal in 1850, a year classified as relatively wet (Klein et al., 2016), occurred during the month of November. The weather described indicated severe thunderstorms pronounced as violent, this is further described by the Natal Witness (13 December 1850) as follows:

Durban - On Thursday, the 28th ultimate, this town and neighbourhood were visited by a violent thunderstorm, accompanied with heavy rain. During the flight of the storm the electric fluid struck the chimney of a brick house belonging to Mr H. McDonald doing about £10 worth of damage. The mast of the "Rosebud" was also struck, but no material damage was done, and we do not hear of any loss of life or personal injury. Locusts have visited Verulam and the chief of the locations in this district, and have done considerable damage; but through the active exertions of the settlers they were driven off. Fenniscoles belonging to J. Leyland Fielden Esq., a patch of mealies was eaten to the stumps, and apparently the plants were destroyed; but, in less than a fortnight, they are again in broad-leaved luxuriance, and promise an abundant crop although it may be a week or two later than it would have been (Natal Witness 13 December 1850).

The 1851 locust outbreak in KwaZulu-Natal was during a year classified as having seasonal rains (Klein *et al*., 2016). No particular damage was recorded for mentioned crops such as maize and potatoes as undescribed measures were adopted in order to protect crops from locusts (KCM 98/6/1/1. BLAMEY, John Cardell. Diary 1851-52). Outbreaks appeared: after weather was described as hot and dry; and preceding a night of rainfall (KCM 98/6/1/1. BLAMEY, John Cardell. Diary 1851-52). Literature by Lima (2007) highlighted that locust outbreaks are statistically related to cold and wet periods, while their outbreaks are frequent during periods that are characterised by frequency of floods and droughts. Further research

by Hanrahan and Home (1997) suggests that rainfall plays a key role in the viability and development of locust eggs. Locust eggs increase in numbers prior to winter due to limited hatching, however after lengthy periods of drought, following adequate rainfall large scale egg hatching occurs (Hanrahan and Home, 1997). This scenario of outbreaks described in KwaZulu-Natal by the missionary John Cardell Blamey coincides with the literature by both Lima (2007) and Hanrahan and Home (1997) who indicate the link between locust outbreaks, periods of drought and rainfall:

"*Weather fine, hot and dry after the night rain. About 10 o'clock we had myriad of locusts and could have done much damage to the mealies and potatoes if we did not protect them*" (KCM 98/6/1/1. BLAMEY, John Cardell. Diary 1851-52).

Although KwaZulu-Natal was not facing crop damages from locusts in 1851, this was unlike the case for the Kalahari which faced a food crisis during 1853 due to locust outbreaks. This also indicates that the outbreaks were widespread as locust swarms seemed continuous across central southern Africa. Miscellaneous religious responses were also documented as a means of protection from such locust outbreaks. These have been recorded and described as follows:

"*The continuation of immense swarms of locusts make times perilous as it regards food… we exhort our people that while they sometimes pray for rain to seek also protection from locusts which are one of Jehovah's armies*" (LMS C 28-1-C R. Moffat Kuruman 12 November 1853).

Seven years later, locust outbreaks appeared again in southern Africa during the mid-1860s until the mid-1870s. The total number of documented counts for locusts during this period was 76, with impacts more widespread again in the Karoo region, which received 54 documented references to locust outbreaks. The Kalahari had four mentions of outbreaks, with two of these years being relatively wet periods in summer, one relatively dry period in summer and an unclassified year due to missing data. Nine widespread outbreaks were recorded in Lesotho during 1864-1869 with four of these outbreaks occurring in relativity dry years in 1868-1869, while two of these years (1866-1867) were classified as normal and two years (1864-1865) were very wet periods with floods. Very wet periods and floods were recorded for the Karoo in 1867 and 1868, particularly during the autumn months when widespread outbreaks of locusts were documented (Collett Diaries 27 March 1867, Collett Diaries 6 April 1867, Collett Diaries 24 April 1867, Collett Diaries no date March 1868). Namaqualand had one outbreak, recorded in 1867 during a very dry/drought year which was widespread and coincided with an ENSO event (Kelso, 2010). Such droughts reported for Namaqualand could have been accompanied by severe locust outbreaks during this period.

The impact of the great drought in 1867 coupled with locust outbreaks in Namaqualand, is further described in the report of the Civil Commissioner (1867) as follows:

"*This cheerful view of things has not been wholly realized not wholly disappointed. Great hopes then drought and locusts have deprived many of their crops and have thinned their flocks, while lung sickness has added something to their distress, but on the other hand, the crops and veldt have recovered from the ravages of the locusts to a far greater extent than was anticipated and many who despaired of … any produce have able to reap a moderate harvest, while trade has been revived in a healthier shape, and now that the ruinous nature of the long credit system has been fully revealed may be expected to maintain that sound relation to the profits of the dealer and the wants of the consumer who alone can render it an advantage to the community in which it is carried on*" (Letters of the Civil Commissioner, 1867).

Although the Kalahari region was documented to have had abundant rains in the previous year (1868), locust outbreaks were documented during a relatively dry winter in July 1869 (LMS C 35-2-D W. Ashton Lekatlong 6 July 1869). The documented impact of such outbreaks had an impact on pastures; however in comparison to the previous winter, the quantity of food resources was better in 1869 than 1868. This is further described in the quotation below:

"*We had abundant rains in December and January over the whole country which tho' too late for native corn were in time for maize, pumpkins and beans so the people got some food after all and had the locusts not followed there would have been an abundance of grass, but even now we are much better off this month than we were last [winter*]." (LMS C 35-2-D W. Ashton Lekatlong 6 July 1869).

December of 1866 in the Karoo was a period of plentiful resources (Collett Diaries, no date December 1866). It was documented as a year during which pasturage was abundant, with pasturages described as being green and crops were described as prodigious (Collett Diaries no date, December 1866). Further descriptions of abundant water supplies and unusual quantities of crops were mentioned (Collett Diaries, December 1866). Such a year described as plentiful created favorable conditions for the 1867 locust outbreaks, which is further described in the Collett Diaries as follows:

"*Locusts that curse and bane of South Africa here again today*" (Collett Diaries 27 March 1867)

"*Locusts made their first appearance in our neighbourhood today*" (Collett Diaries 6 April 1867)

Particular interventions in the Karoo, such as the burning of fires, were documented as a coping mechanism during 1867 to prevent the further spread of locust and to protect crops

(Collett Diaries, 24 August 1867). However, despite such measures to cope with locusts, the outbreaks of 1868 threatened pastures and the possibility of having a famine condition remained certain.

"Pasture unprecedented dams full but our anticipation of an abundant winter may not be realised as locusts by myriads have made their appearance" (Collett Diaries, no date March 1868).

Locust outbreaks were documented 14 years later (1891) after the last outbreak in 1875, with widespread impacts in KwaZulu-Natal and Lesotho. The majority, which accounts for 71% of these documented outbreaks in KwaZulu-Natal, occurred during very dry/drought years and relatively dry years. Towards the 1890s, locust outbreaks were more frequent and widespread, particularly in the KwaZulu-Natal and Lesotho regions. The impacts of locusts during the period 1892-1899 were particularly devastating to crops in KwaZulu-Natal, Lesotho and the Kalahari towards the end of the century (LMS C 49-2-B E. Lloyd Kanye 28 November 1892, LMS C 53-1-C H. Williams Molepolole 27 March 1896, LMS R Box 2 H. Williams Molepolole no date, 1896, LMS R Box 2 W. Ashton Barkly 28 December 1896, LMS C 54-1-A W. Ashton Barkly 18 January 1897, SPG E47b (1892) Report of Rev. T. Woodman, Masite, for the quarter ending 31 March 1892, Great Britain (1892) Basutoland: Annual Report for 1891-92. Colonial Reports – Annual, No.62. HMSO, London, GLD Sir Godfrey Lagden Diaries RH MSS.Afr.s.165).

Lesotho was also encountering an economic crises due to the outbreak of locusts in 1892 (Danziger, C. (1979) A Trader's Century: the Fortunes of Frasers. Purnell, Cape Town). According to literature by Kishindo (1993), Lesotho grew trade crops such as wheat. The impacts of locusts on such trade crops would therefore have a major setback to the local economy of the region. Such is described by Danziger (1979) as follows:

p.30 "*In 1892, a plague of locusts dealt another blow to the economy of Basutoland*" (Danziger, C. (1979) A Trader's Century: the Fortunes of Frasers. Purnell, Cape Town)

The effects of locusts on crops in KwaZulu-Natal was widespread and severe, during the 1890s (USPG E50c, S.M. Samuelson, St Paul's, Zululand, 31 December 1894, Natal Witness 9 November 1894,USPG E50d, S.M. Samuelson, St Paul's, Zululand, 31 March 1895Harvard, Ransom, Charles N., Amanzimtote (Adams), report for June 1895 to June 1896,Harvard, Houghton Library, ABC 15.4, vol. 13, Southern Africa, Zulu Mission 1890-99 Gertrude Hance, Esidumbini, report, 1896 Houghton Library, ABC 15.4, vol. 13, Southern Africa, Zulu Mission 1890-99). This could be owing to the expansion of croplands and expansions of a variety of

food sources introduced by missionaries. Such evidence of crop expansion is further discussed by Ballard (1983), who indicates that towards the late 19th century, black Natal farmers had to cultivate crops such as maize and sorghum to keep up with the demands from a political economy. In KwaZulu-Natal, crops such as maize and sorghum were therefore widely produced to continue supply to the local markets. The majority (23) of these outbreaks were documented in very dry/drought years and 16 were documented during relatively dry years. Locust outbreaks in regions such as the Karoo and Namaqualand were less documented towards the end of the 19th century. Although the Kalahari had locust outbreaks documented towards the end of the 19th century, they were not recorded as frequently as in KwaZulu-Natal. Reported outbreaks of locusts in KwaZulu-Natal, in 1895, further threatened food security and indigenous people feared that many would be faced with starvation as a result of crop destructions caused by locusts (USPG E50d, S.M. Samuelson,St Paul's, Zululand, 31 March1895). Some recorded consequences of locusts also resulted in population dispersal on account of hunger (USPG E51b, S.M. Samuelson, Polela, 31 March 1896). Other consequences mentioned was school attendance, which was reported as lower than usual and was further affected by locusts amidst a scarcity of food, and severe sicknesses and deaths were even recorded (Harvard, Houghton Library, ABC 15.4, vol. 13, southern Africa, Zulu Mission 1890-99). During the year 1896, miscellaneous responses undertaken by Zulus involved prayer meetings which were conducted day and night to get rid of the plagues (Harvard, Houghton Library, ABC 15.4, vol. 13, Southern Africa, Zulu Mission 1890-99, Groutville: Umvoti and Mapumulo stations report for the year ending 30.6.1896).

Interestingly, in 1894, interventions in KwaZulu-Natal that were adopted to rid the Natal colony of locusts involved using fires to burn off locusts. Such an intervention did not prove to be successful, with locust swarms continuing to wreak havoc on local farms:

"An Immense Swarm. From the information gleaned it would appear that the swarm came from the direction of Table Mountain and passed over Camperdown. They made a halt over Tom Evans' farm, where everything was going on, but were prevented from alighting owing to the prompt measures taken by Mr Evans to avert such a disaster. A light was set to the grass in the vicinity, paraffin tins were beaten, and added to this the din created by the kafirs, the pests continue their flight, and at sundown settled near Mr Baker's farm" (Natal Witness 1 September 1894).

"Our Stanger correspondent send us news of a serious character. He states that the locusts have visited the district, and have destroyed acres of mealies and beans..." (Natal Witness 9 November 1894).

Very wet/Floods	Relatively wet	Seasonal Rains	Normal	Relatively Dry	Very dry/Drought	Unclassified /Missing data	Insufficient Evidence

Table 5-2: Documented Locust outbreaks for the Kalahari per month

	Outbreak year	January	February	March	April	May	June	July	August	September	October	November	December
Kalahari	1836												
	1843												
	1853												
	1869												
	1871												
	1874												
	1875												
	1892												
	1896												
	1897												
	1898												

Table 5-3: Documented Locust outbreaks for Namaqualand per month

	Outbreak year	January	February	March	April	May	June	July	August	September	October	November	December
Namaqualand	1841												
	1842												
	1843												
	1867												
	1894												

Table 5-4: Documented Locust outbreaks for the Karoo per month

	Outbreak year	January	February	March	April	May	June	July	August	September	October	November	December
Karoo	1832												
	1836												
	1840												
	1841												
	1842												
	1843												

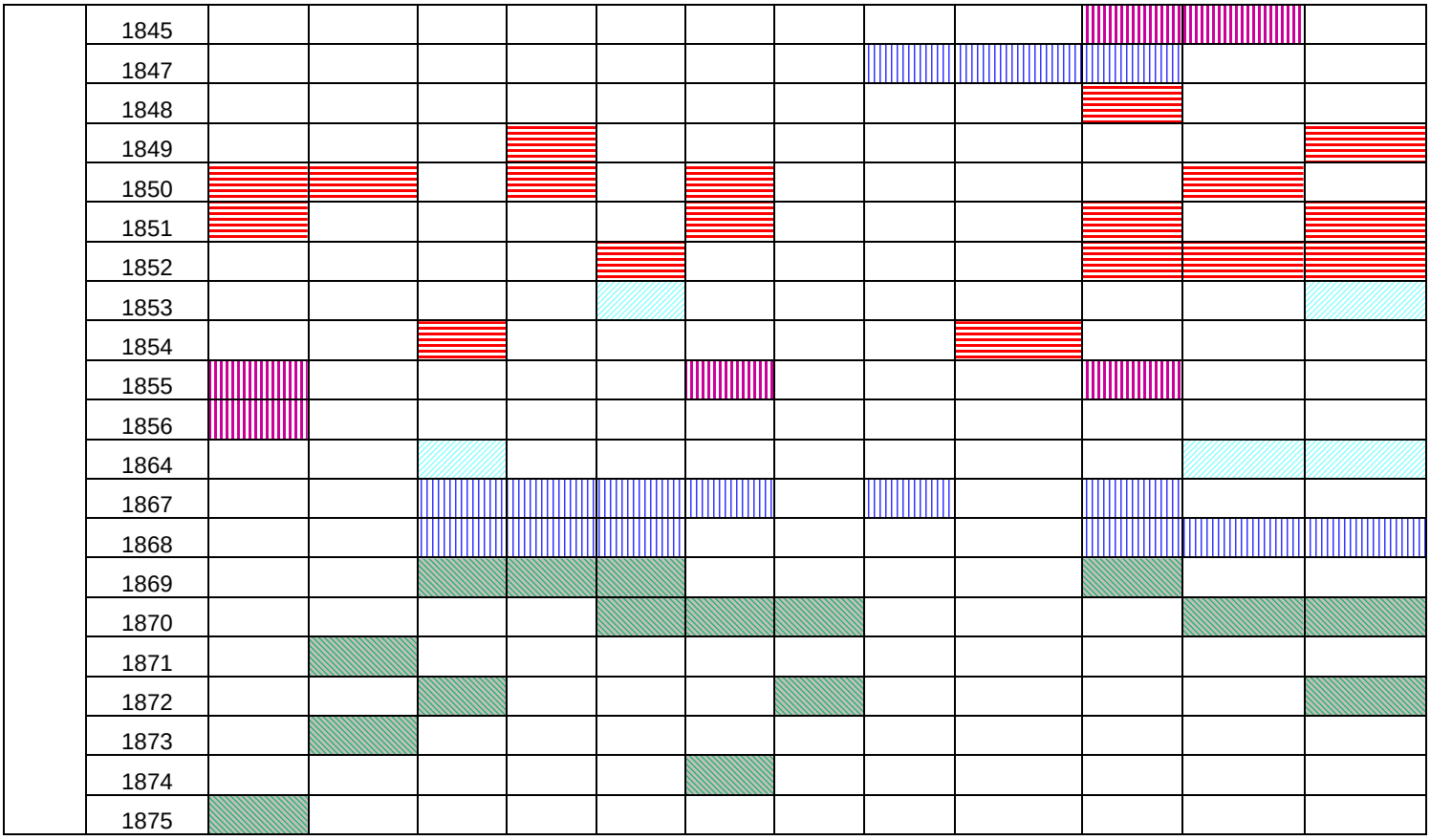


Table 5-5: Documented Locust outbreaks for Lesotho per month

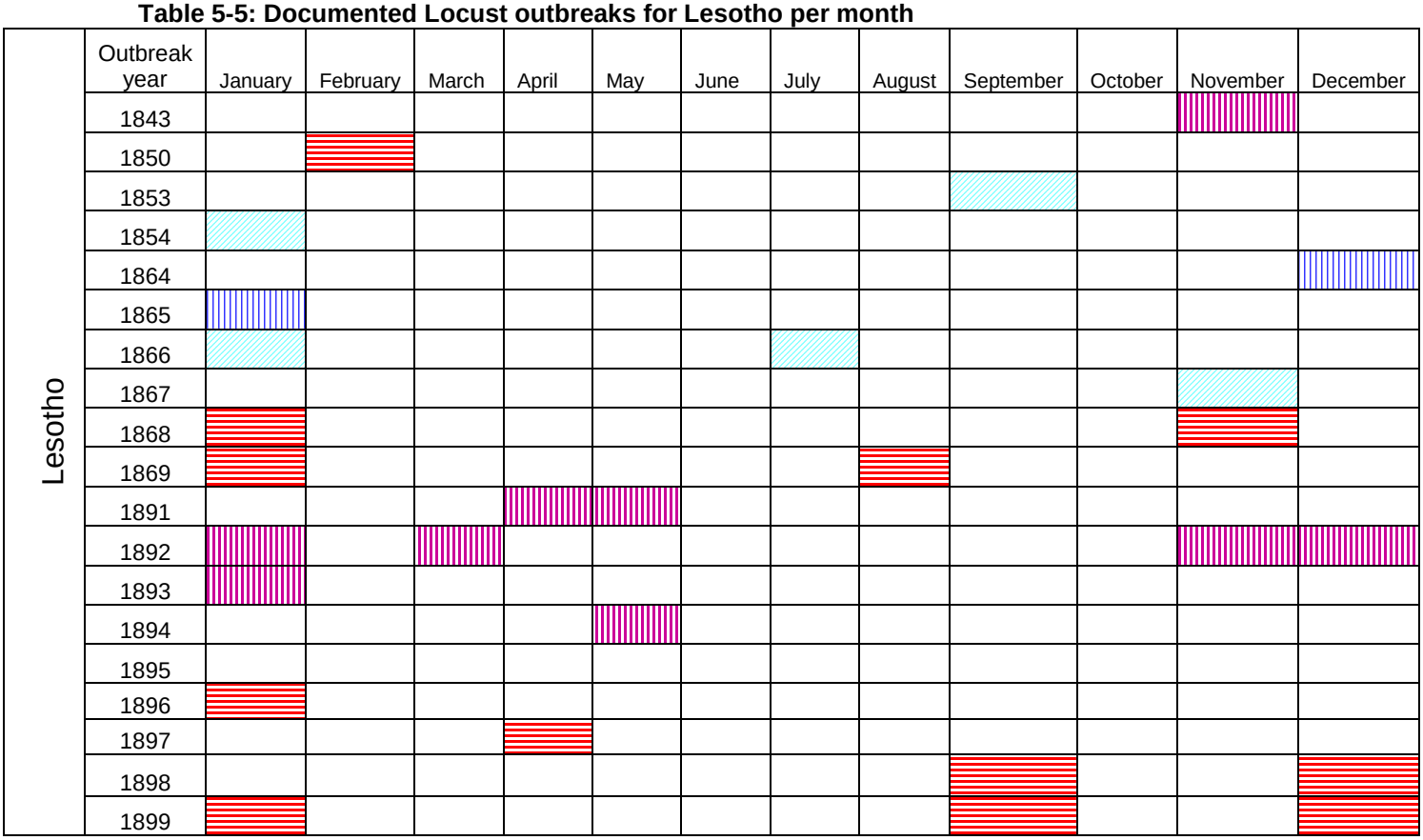
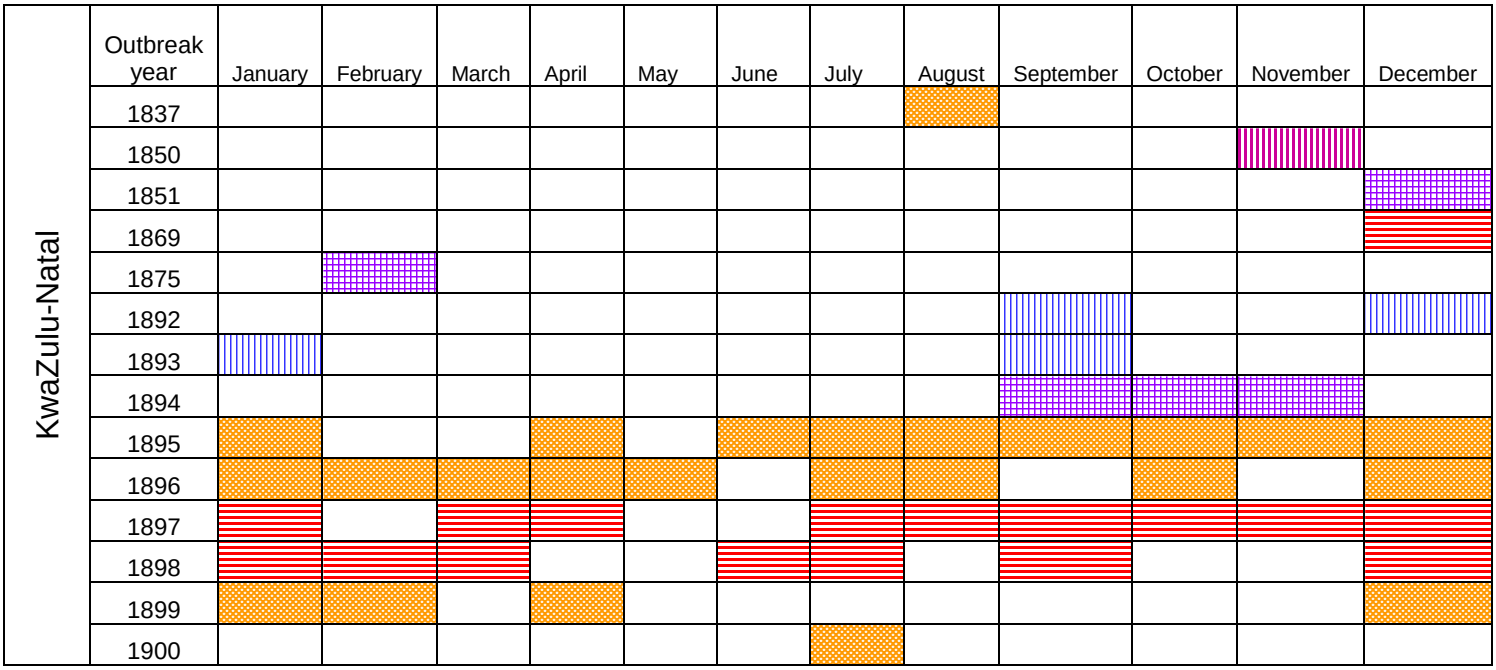


Table 5-6: Documented Locust outbreaks for KwaZulu-Natal per month



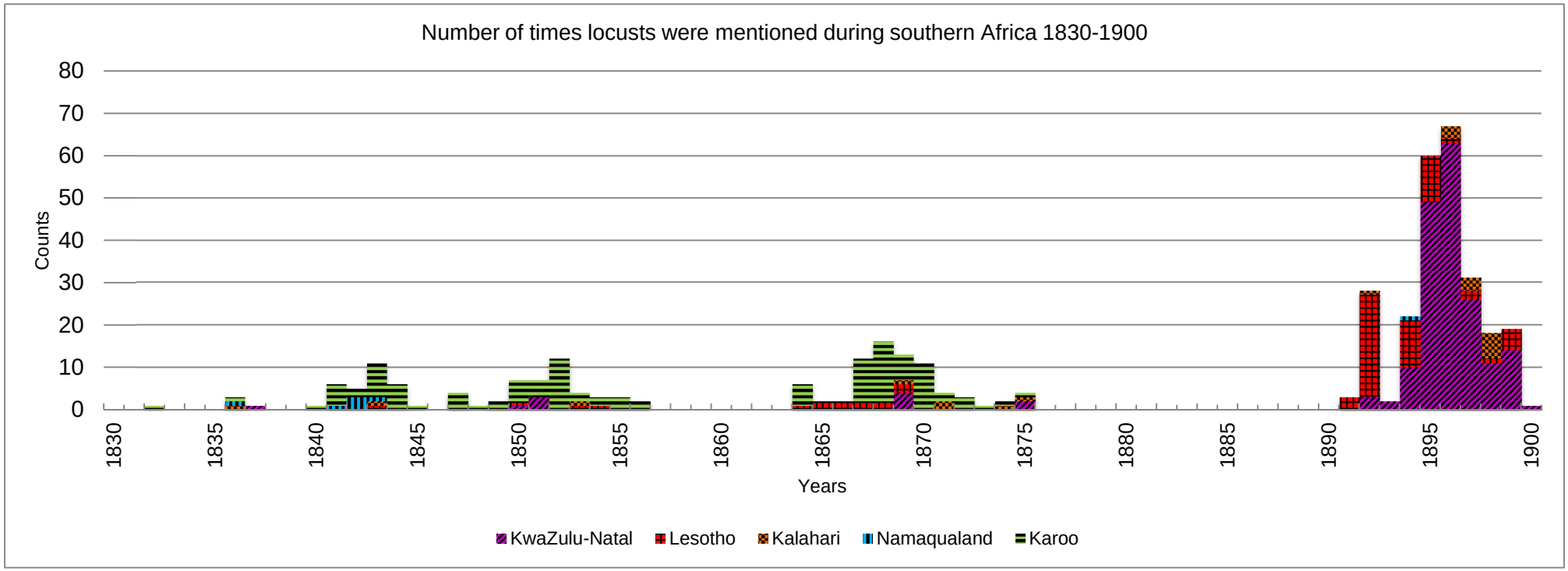


Figure 5-6: Frequency counts of locust outbreaks across southern Africa during the 19th century

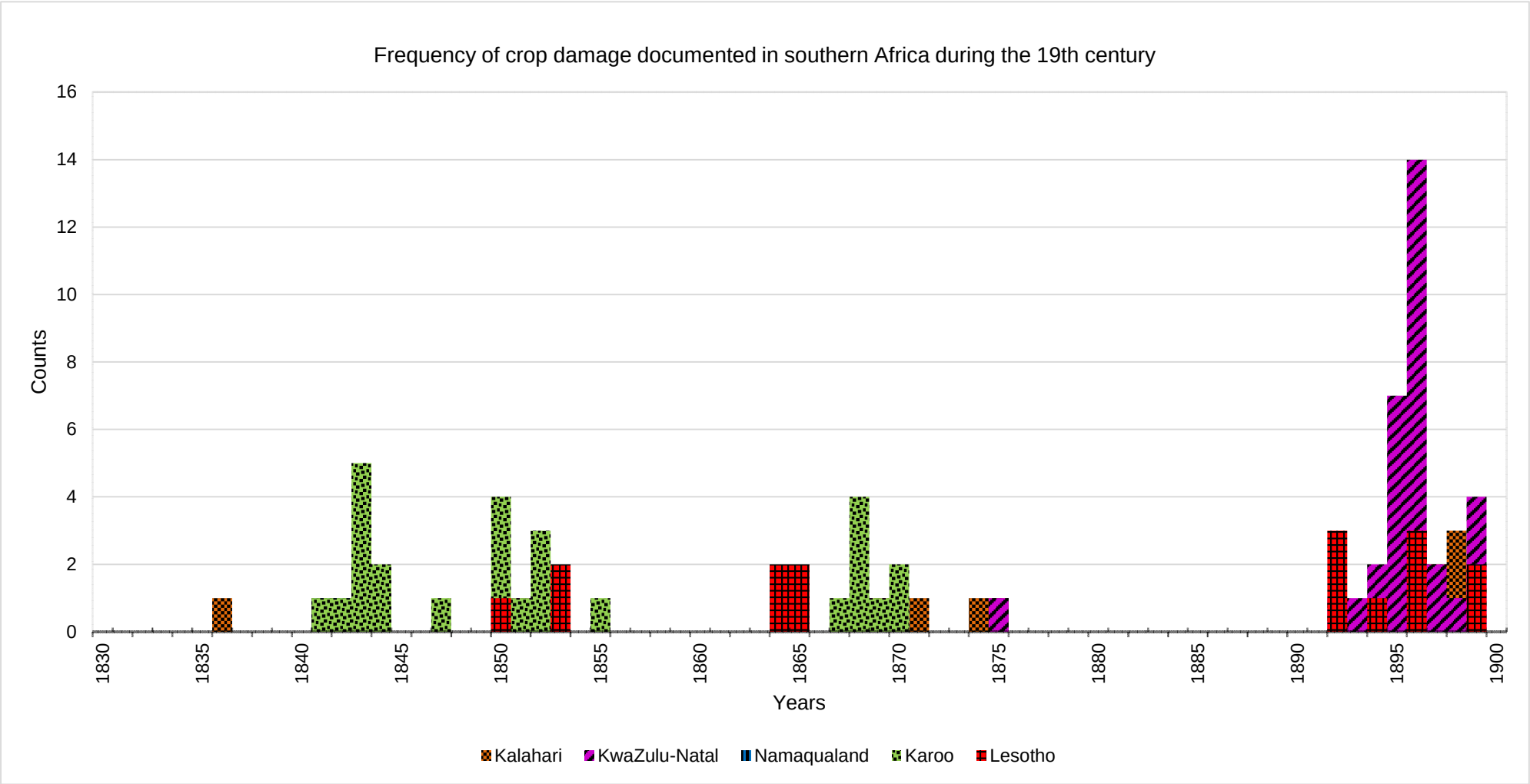


Figure 5-7: Frequency counts of locust outbreaks affecting crops across southern Africa during the 19th century

5.4 Environmental Impacts: Drought, Floods and Famines

5.4.1 Drought impacts

The documented evidence of climate history in southern Africa during the 19th century comprised of historical accounts of river/stream/spring levels, observations of landscape changes such as scarcity or abundance of grass, as well as water scarcity during periods of droughts. Documented evidence for southern Africa indicates that 36% of very dry years classified as droughts for southern Africa were periods during which desiccation of water resources took place, while 15% of these years were classified as relatively dry years. Such evidence indicates that in most of the region, droughts are a frequent phenomenon. Droughts in southern Africa are also a common occurrence during the warm phase of ENSO (El Niño Southern Oscillation) (Masih *et al*., 2014).

The impacts of such droughts have led to consequences, such as water scarcity, grass scarcity and desiccation of rivers and water courses. The effects of such consequences have been documented in various source documents. Widespread climatic changes influenced demographic trends in southern Africa during the 19th century, as drought forced agriculturalists and indigenous people to seek new areas for cattle feeding and water resources. The element of movement was a characteristic of life for the people of southern Africa, as drought conditions represented an environmental pressure on indigenous people, which forced them to respond in various ways (Mabogunje, 2000).

5.4.2 Water scarcity

Fifty seven of the years documented during the 19th century mentioned water scarcity in the southern African region (Figure 5-8). This was a result of desiccation of rivers/streams/wells/springs which impacted on water availability. The implications of such water scarcity in southern Africa were felt on human health reported in the Kalahari during 1843 (LMS C 20-1-B H. Helmore Lekatlong 12 December 1843). In Lesotho, the consequences of water scarcity meant that indigenous people had to pay for water in order for livestock to drink (PEMS AA FBN1 Mf.40. Maeder, F. Béerséba. 30 Avril 1838**).** Widespread scarcity of water and droughts in Lesotho described during 1833-1834 triggered population dispersal in the region, with many indigenous people also travelling great distances in search of the resource (PEMS AA FBN1 Mf.13. Lemue, P. Motito. 1er Janvier 1833, PEMS AA FBN1 Mf.17. Gosselin, C. Morija. 24 Avril 1834), while in Namaqualand water scarcity recorded during 1833-1834 resulted in severe impacts on corn crops (Report of the London

Missionary Society, presented at the General Meeting of the Missionary Society, held May 15, 1834, 99).

"*Water is not satisfying the needs of the population, which means that during times of drought, the inhabitants have to travel great distances to obtain a sufficient quantity of water for themselves and for their animals*" (PEMS AA FBN1 Mf.13. Lemue, P. Motito. 1er Janvier 1833).

The scarcity of water has caused many hardships in Lesotho. Many springs in the region were dried up, and the quantity of water was described as being insufficient to run a mission station (PEMS AA FBN1 Mf.17. Gosselin, C. Morija. 24 Avril 1834). Seasonal rains were also described to be delayed over two harvesting seasons, while widespread droughts persisted in the region (PEMS AA FBN1 Mf.17. Rolland, S. Station du Calédon. 25 Mars 1834). Missionaries and travellers in Lesotho further describe such hardships in the Morija region due to water shortages, and people consequently had to travel longer distances in search of additional water sources due springs having dried up, as described below:

"*16 November 1833. Travelled to see if we could not find water more abundant than Morija. Sirs you ask why. This is because one of our springs has dried up so much that there is very little water for a station*" (PEMS AA FBN1 Mf.17. Gosselin, C. Morija. 24 Avril 1834).

Persistent and widespread droughts recorded in KwaZulu-Natal in 1836-37, not only had a negative impact to crops, but caused the region to be destitute in terms of water resources (Bird, John (1888) The Annals of Natal, 1495 to 1845. Vol. 1.P. Davis, Pietermaritzburg). As a result of such hardships this triggered the migration of indigenous people of Natal to seek refuge in other lands. The migration of people in 1837 in KwaZulu-Natal was also a result of a continuation of a dry spell which impacted on the availability of water (ABC Film 467 Volume 2 Oct 5th 1837). By the year 1847, water was still in demand in KwaZulu-Natal, with the region experiencing low river levels (Natal Witness 16 October 1847). Due to such demand for water municipal water regulations in KwaZulu-Natal were introduced in 1847 as a physical measure against resource shortages (Natal Witness 16 October 1847). Such water regulations were also perceived as a means of improving water management in order to manage and utilise the scarce resource sustainably. A later intervention adopted by KwaZulu-Natal in 1859 was the implementation of watering carts, which were imported by municipal authorities and observed to be a municipal response to water scarcity (Natal Witness 24 June 1859).

The occurrence of migration in Namaqualand documented in 1855 highlighted that the impact of migration had an effect on population numbers in the region. Population dispersal triggered

by severe droughts have also led to local indigenous people engaging in transhumance practices, searching for water and pasturage in other regions elsewhere. Documentary evidence in the form of a letter from Rev, Richard Ridgill (1856) further describes the population dispersal in search for water:

"[Arrived at Nisbett-Bath on the 21st of November, 1855]. I found a few families residing on the station, and the number has since decreased. A drought of twelve months' continuance dispersed the people through the length and breadth of the land in search of water and pasturage for their flocks and herds" (Extract of a Letter from the Rev. Richard Ridgill, dated Nisbett-Bath, March 13th, 1856, Missionary Notices, 1856, 164).

Namaqualand was struggling to recover from a long continued drought in 1875. The region was experiencing the ongoing impacts of drought from previous years (Civil Commissioners Report, 1875). The ongoing effects of such a drought had serious implications for water scarcity in the region (Civil Commissioners Report, 1875). The implications of delayed rains have also had an impact on the quantity of crops that were reaped (Civil Commissioners Report, 1875). Widespread droughts were also combined with other social issues being experienced in the region during 1875 such as poverty amongst the middle class which resulted in people coping by subsisting on corn, milk and roots (Civil Commissioners Report, 1875). The hardship of water scarcity continued well into 1876, with low crop yields being experienced on account of lack of water (Civil Commissioners Report, 1876). By 1890, droughts in Namaqualand were also causing heavy stock losses, further diminishing water supplies, and resulting in crop failures (Mission Stations Namaqualand: Diverse Matters 1905 [Cape Town 1/ Letters G]. A variety of environmental characteristics on the Kalahari region is commented on in 1841 (LMS DL Box 2 D. Livingstone Kuruman 2 December 1841). These descriptions provide some insight to the environmental changes that were taking place in the Kalahari during this year. The general description of the climate was depicted as being dry but pleasant (LMS DL Box 2 D. Livingstone Kuruman 2 December 1841). However, water resources were documented to have been dried up/stagnant and rivers were described as having "n*ot a single drop of water flowing in them*" (LMS DL Box 2 D. Livingstone Kuruman 29 July 1843). Water scarcity was widespread during 1841-1843 in the Kalahari (LMS DL Box 1 D.Livingstone Kuruman 22 December 1841, LMS C 18-3-A W. Ross Kuruman 5 July 1842, LMS DL Box 2 D. Livingstone Kuruman 29 July 1843). The impacts of water scarcity for the Kalahari region also affected domestic use of water, missionary R Edwards, reported the following in 1841 in the town of Bakwena:

"*arrived at a Bakwena town with "scarcely water for domestic use*" (LMS C 18-2-B R. Edwards Kuruman 8 December 1841).

The impacts of the drought in 1848 in the Kalahari region made water supplies further stagnant. Dry seasons contributed to the scarcity of water along the Kolobeng River, as described further below:

"*We have no rain - one good shower alone this year while all around as the rains have been abundant. The Kolobeng gets smaller and smaller but has not run in to the water course for the last three weeks". "This is the fourth year of scarcity"… "Last year at this time we could not make our water course contain water but two dry seasons following each other seems too much for it"* (LMS DL Box 5 D. Livingstone Kolobeng (no date) November 1848).

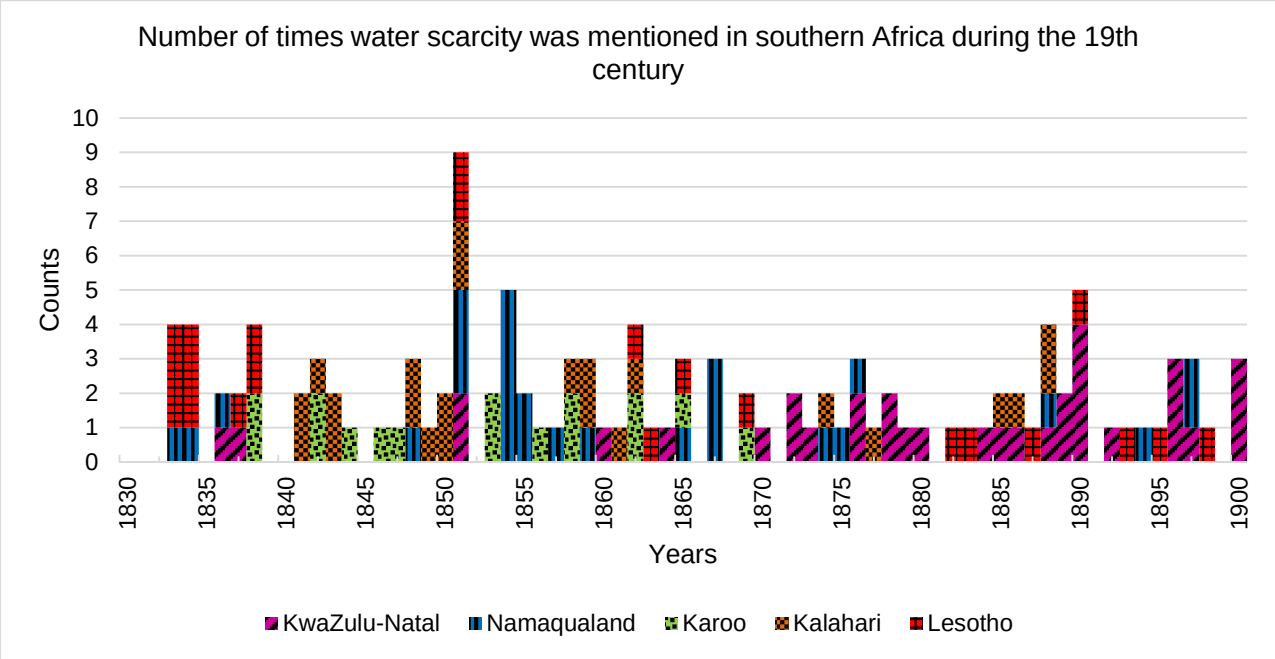


Figure 5-8: Documented water scarcity for southern Africa during the 19th century

Documented evidence for KwaZulu-Natal in 1860 indicated that water scarcity during prolonged droughts triggered the movement of people in search for water elsewhere, as livelihoods such as clay making were dependent on water supplies, this is descried further by missionary A Tonneson (1860):

"About six weeks ago water near here became insufficient for our use, so we had to get it from very far and consequently could only bring a few buckets a day. In this way only a small quantity of clay could be made ready. We kept on for some time and did what was necessary. Then we had to give it up and discharge the people except two, hoping to get rain; but we have been disappointed and thus as before mentioned the house remains partly plastered" (USPG E7, A. Tonnesen, Umgababa, Lower Umkomosi, 1 August 1860).

The Cape of Good Hope (Colony) Blue Books (1861) reported that water scarcity for the Karoo regions were a result of droughts and the impact to local wells resulted in the drying up of 20 to 30 feet depths of such wells due to droughts reported in the year 1861 for the region (Cape of Good Hope (Colony) Blue Books, Cape Town, Richards. P JJ 27: Year of 1861 *Appendix: Burgersdorp*). As a consequence of droughts, water could no longer be obtained from such wells. However by 1865, water scarcity recorded in the Karoo described interventions being undertaken by locals. Such interventions included the sinking of wells on private property (Cape of Good Hope (Colony) Blue Books, Cape Town, Richards. P JJ 31: Year of 1865 *Appendix: Bedford*). This intervention has also resulted in farmers sinking wells on their farms to obtain water for agricultural purposes (Cape of Good Hope (Colony) Blue Books, Cape Town, Richards. P JJ 31: Year of 1865 *Appendix: Bedford*). This is further explained:

"*Water has been scarce in the village that wells have been sunk on private property, and excellent water has been obtained at the depth of fifty-seven feet. Neighbouring farmers, hearing of this, are now sinking wells upon their arid farms*". (Cape of Good Hope (Colony) Blue Books, Cape Town, Richards.P JJ 31: Year of 1865 *Appendix: Bedford*).

The sinking of wells was only adopted by 1894 in regions like Namaqualand (J.T. Eustace, Civil Commissioner and Resident Magistrate, Namaqualand No date). Indigenous people in Bushmanland attempted to sink wells, however this proved to be unsuccessful in trying to find water (J.T. Eustace, Civil Commissioner and Resident Magistrate, Namaqualand No date). Nevertheless, indigenous people remained hopeful that the holes made will obtain water when rains do arrive (J.T. Eustace, Civil Commissioner and Resident Magistrate, Namaqualand No date).

Water scarcity continued well until the end of the century in KwaZulu-Natal. By 1890 the region was faced with a water famine, despite recent rains which occurred during that year, the region still experienced water shortages. Rivers at the coast were drying up and were at low levels, however the rains experienced were not heavy enough to fill up dams and reservoirs for the region to recover from water scarcity (Natal Witness 1 October 1890). This scenario is described in the Natal Witness:

"*Durban. In spite of the recent rains, Durban's water supply is at a very low ebb, and were it not for the Umhlatuzan special supply and the rainwater tanks Durban at the present time would actually be experiencing a water famine. The total rainfall for October was over and inch-and-a-half above the average for the last 15 years, and yet the smaller coast rivers have seldom been lower than they are at the present time. The light rains have very little effect on*

the Umbilo River, but a heavy downpour would rapidly fill the reservoir" (Natal Witness 1 October 1890).

Regions such as Ladysmith were also encountering a water famine in the year 1890. Although the general appearance of the climate appeared to be overcast, no rains fell. Rivers such as the Klip remained still and it appeared that this river remained stagnant for a long time (Natal Witness 12 October 1890). As a result of lack of rains and low river levels, water famine is mentioned again in KwaZulu-Natal in 1890. It also appeared that there was much conflict over limited water resources, such that interventions were put into place to prevent people from using more water than they should (Natal Witness 12 October 1890). Police were described to be stationed at various water points to ensure that this did not happen (Natal Witness 12 October 1890). The impacts of water scarcity were also affecting oxen which resulted in their low state of health due to lack of water (Natal Witness 12 October 1890). This is detailed further in the quotation below published in the Natal Witness:

"Ladysmith. *For ten days past the sky has been overcast and every appearance in the sky of rain, yet not a drop has fallen here, although we hear of heavy falls towards Sunday's River and on the Berg. If there has been such in the last named region it has all found its way into the ground, for the Klip River is almost stagnant, and the water famine in this town continues. So fierce is the competition for the trickling stream of the precious fluid pumped into the main sluit that policeman have to be stationed at various points to prevent the greedy from taking the whole supply. Notwithstanding such precautions you will see a full stream of water being discharged into a garden here and there and running continuously, whilst hundreds of people have not a drop led near their dwellings - not enough for domestic purposes, let alone gardening operations. The supply of water is so short up at the dam that the Local Board, even with the air-pump they have, are afraid of working more than 12 hours a day, lest they should run the River dry. As to the transport riders they say their oxen might just as well die in the yoke pulling a wagon along the main roads as die on their farms, whilst roaming about in search of a mouthful to eat; and so transport operations on a certain scale are being resumed*". (Natal Witness 12 October 1890).

However the Natal Witness (11 March 1893) clearly highlights that by 1893, the breakup of a drought indicated in KwaZulu-Natal resulted in water scarcity no longer being a consequence of severe droughts. Cases of flooding in Ladysmith were described for 1893:

"*For the past few days the weather has been cloudy, with indications of heavy storms on the Berg slopes, and on Monday night there was a heavy downpour here. No apprehension was felt, however, as to the River on Tuesday, when the water, which had been high, began to*

subside. After midnight, some of the most watchful dwellers on the low ground saw the volume of water increasing very rapidly, and an alarm by the church bells was sounded, rousing people out of their beds about one o'clock the River overflowed its banks in several places… I hear that there was a considerable wash away on the Harrismith extension of the railway line" (Natal Witness 11 March 1893).

Other indications of the region recovering from water scarcity are further described in the Natal Witness (19 October 1895):

"Estcourt. The drought has broken at last. All Saturday afternoon, about five o'clock, we had a heavy thunderstorm, accompanied by a good downpour of rain, and at one time by a sharp fall of good sized hailstones. In a very short time the main streets of the village were flooded, giving one the impression that a waterspout had burst somewhere in the vicinity" (Natal Witness 19 October 1895).

However by the winter of 1896 (Natal Witness 9 July 1896), KwaZulu-Natal was faced with yet more severe water shortages due to a dry spell in the region. Rain was needed while water tanks were described as emptying fast with roads described as dry and dusty (Natal Witness 9 July 1896). By August, the region experienced its first heavy rain of the season, indicating breaking up of the dry spell and restoring water levels (Natal Witness 27 September 1896). Evidence of such a recovery is highlighted further in the Natal Witness (27 September 1896):

"*Heavy rain in Durban. Stores flooded. The first heavy rain of the season - the breaking up of the winter - fell in Durban on Sunday. The unusually hot winds experienced during the early part of the last week (says the Mercury) had the effect of scorching up vegetation, already impoverished by the long continued dry weather, and the call for rain became pretty general. On Friday evening there was a refreshing fall, and throughout Saturday the sky threatened a down pouring, which was realised later in the day. There were intermittent showers in the evening, accompanied in Durban by distant lightning, but not till yesterday the rain fall in any great quantity…. The quantity of water which fell was enormous, and many parts of the town became flooded*" (Natal Witness 27 September 1896).

Lesotho also had widespread water scarcity until 1898. While regions like Namaqualand and the Kalahari may have recovered from water scarcity, in Namaqualand it was only recorded once in 1897. Towards the end of the century in Namaqualand, years such as 1899 and 1900 were classified wet years (Kelso, 2010), which meant that the region recovered from droughts and water scarcity could have been broken up during such wet years. KwaZulu-Natal had the most documented cases of water scarcity until 1900, which indicates that the region did not

quite recover from the shortage of water, although various interventions such as water restrictions and the use of rain water tanks to supply water. This was due to the fact that 1896 was classified as a drought year, while during 1897 conditions were relatively dry, and by 1900 very dry/drought conditions persisted in KwaZulu-Natal (Klein *et al*., 2016). This explains why water scarcity continued to be an issue in KwaZulu-Natal.

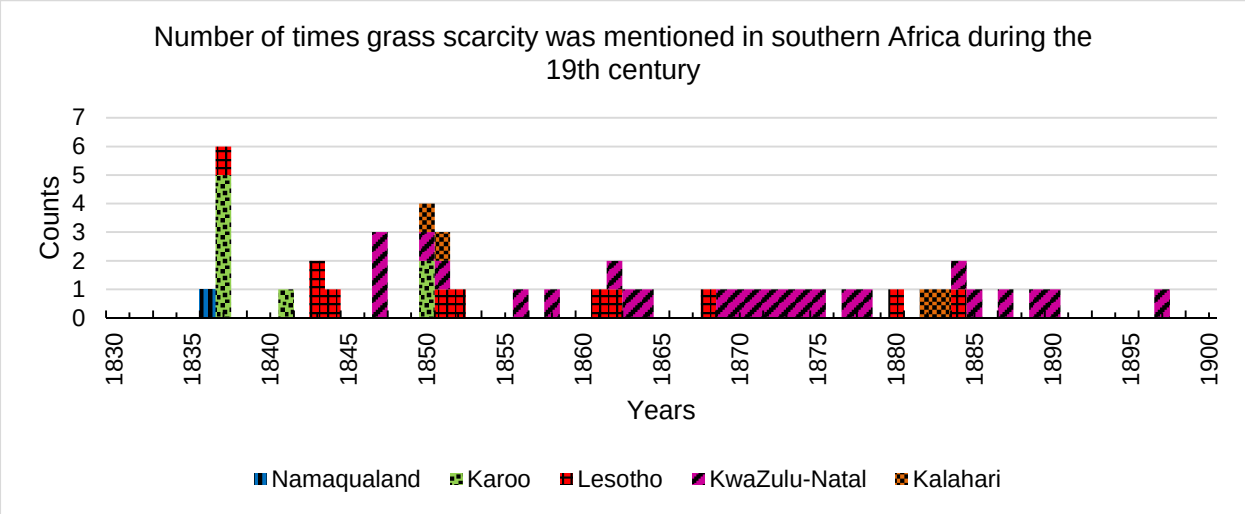


Figure 5-9: Documented grass scarcity for southern Africa during the 19th century

The scarcity of grass during droughts in southern Africa had negative impacts on livestock farmers and cattle breeders in the region. Such impacts had serious implications for livelihoods in southern Africa (Table 5-7). The impacts of grass scarcity in the Kalahari region during 1850 resulted in landscape changes (LMS C 25-1-B R. Moffat Kuruman 28 March 1850). Such landscape changes were discussed in terms of the quality of pastures and documented evidence indicated that there was not a blade of grass for oxen to feed on, as such numerous deaths of oxen were mentioned (LMS C 25-1-B R. Moffat Kuruman 28 March 1850). Missionaries in Kuruman also described the impacts of grass scarcity in 1850 on cattle indicating that cattle were dying from hunger (LMS C 25-1-B R. Moffat Kuruman 28 March 1850). Likewise the diary of John Fleming also documented grass scarcity affecting cattle in KwaZulu-Natal in 1851 due to droughts (KCM 98/65 FLEMING, John. Extracts from John Fleming's Diary, 1850-1891). Extended periods of droughts in KwaZulu-Natal were also documented to be responsible for impacting on stocks (Natal witness 9 March 1869). A miscellaneous response in KwaZulu-Natal during 1878 was that farmers were using sugar cane as feed for horses during a period of grass scarcity (Natal Witness, 6 October 1878).

Similar impacts to oxen were also reported in 1871 in the Kalahari region (LMS C 36-3-D C. Williams Molopolole 26 May 1871).The scarcity of grass caused by locust damages resulted and impacted on pasturage conditions for oxen (LMS C 36-3-D C. Williams Molopolole 26 May

1871). Severe locust outbreaks in 1875 in the Kalahari region also impacted pastures and the scarcity of grass reported in this year resulted in the death of two oxen (LMS C 38-1-A W. Ashton Kuruman 19 January 1875). Grass scarcity mentioned for Lesotho as early as 1837, a relatively dry year, indicated that the region was bare of grass, which had serious implications for oxen which depended on pastures for food.

“The weather was very severe and the country almost bare of grass so that our oxen have suffered very much” (WMMS SA CORRESPONDENCE FBN3 Mf 107. W. Carner, Thaba Unchu, 25 September 1837). Missionaries in Lesotho described fearful droughts in 1853 impacting grass and leading to cattle starvation (PEMS AA FBN2 Mf.77. Pellissier, J.P. Béthulie. 27 Mars 1843). The condition of cattle in Lesotho was particularly poor in 1843 and 1844 owing to a scarcity of grass (PEMS AA FBN2 Mf.83. Maeder, F. Morija. 1 Janvier 1844). Cattle deaths were recorded as a result of grass scarcity significantly reducing pastures to a point where not a blade of grass was available for cattle to feed, this is detailed as follows:

“*The drought was so strong last year that many people saw themselves deprived of any means of subsistence. Their gardens and their corn fields failed following a burning sun which dried every last blade of grass, a great number of their cattle died of starvation*” (PEMS AA FBN2 Mf.77. Pellissier, J.P. Béthulie. 27 Mars 1843).

The Barren Mountains of Morija and Thaba Bossiou were described by missionaries, and their descriptions indicated that grass scarcity was severe such that it was insufficient to feed cattle (PEMS AA FBN2 Mf.83. Maeder, F. Morija. 1 Janvier 1844). Such comparisons were made by missionaries in the surroundings of Morija and Thaba Bossiou to that of Béerséeba:

“*The surroundings of Morija and Thaba Bossiou form a very striking contrast with the surroundings of Béerséeba. There, barren mountains present themselves to us at each step, and the plains strewn with a dry grass are not enough to feed the thin cattle, while here one sees a delightful greenery with which the plains and mountains are completely covered*” (PEMS AA FBN2 Mf.83. Maeder, F. Morija. 1 Janvier 1844).

The impacts of a cold winter reported in June 1851 by traveler John Fleming in KwaZulu-Natal highlighted that grass scarcity had led to the death of oxen from having lack of food (KCM 98/65 FLEMING, John. Extracts from John Fleming’s Diary, 1850-1891). However, general landscape conditions by John Fleming also revealed that the country was facing a dry period with the landscape being described as “burnt”, possibly due to natural fires (KCM 98/65 FLEMING, John. Extracts from John Fleming’s Diary, 1850-1891).However, a year later, the Natal Witness (2 April 1852) published that the native practice of grass burning was a remedy

against pasture losses and scarcity of grass. Such an adaptive approach also led to a considerable quantity of hay being produced during that year (Natal Witness 2 April 1852). However, other interventions displayed in KwaZulu-Natal during grass scarcity in winter involved stacking and storing of hay, which is seen as an effort to store fodder and keep cattle in good condition until the spring season when new grass develops (Natal Witness 28 May 1852).

Table 5-7: Documented Impacts of drought in southern Africa

Region	Grass scarcity	Water scarcity	River desiccation	Documented years	Documented Impact/response	Source
Namaqualand	×			1836, 1851 and 1854	Bushmen tribes trekking for greener pastures Lack of grass for horse feed	Lycett, J., 1854: Journal of a Journey to Namaqualand. University of the Witwatersrand, Historical Papers, A72 Tindall: B.A, 1959: The Journal of Joseph Tindall: Missionary in South West Africa 1839-1855, The Van Riebeeck Society, Cape Town. Wits Library: Africa XX AP DT 821.V12
		×		1833-34, 1836, 1848, 1851, 1854-55,1857, 1859,1865, 1867,1874-76,1888, 1895, 1897,	Insufficient for crop cultivation, digging for water in river beds, water preservation, cattle losses, procurement of water from other regions, indigenous people trekking away in search for water,	Report of the London Missionary Society, presented at the General Meeting of the Missionary Society, held May 15, 1834, 99 Tindall: B.A, 1959: The Journal of Joseph Tindall: Missionary in South West Africa 1839-1855, The Van Riebeeck Society, Cape Town. Wits Library: Africa XX AP DT 821.V12 Bain, 1949:9 Extract of a Letter from the Rev. Richard Ridgill, dated Nisbett-Bath, March 13th, 1856.Missionary Notices, 1856, 164 Lycett, J., 1854: Journal of a Journey to Namaqualand. University of the Witwatersrand, Historical Papers, A72 Civil Commissioner's report, 1863 Tindall, 1959 as cited in Kelso, 2010 Civil Commissioner's Report, 1876) Newspaper Article, Cape Times , 6 September 1895 The Great Thirstland: Namaqualand's Bitter Cry
			×	1836, 1854-55, 1868		H.E. Welby, Acting Civil Commissioner, Namaqualand 21 July 1868

Region	Grass scarcity	Water scarcity	River desiccation	Documented years	Documented Impact/response	Source
KwaZulu-Natal	×			1847-48,1850-51,1856, 1858, 1861-63,1866, 1868, 1870-71, 1873-75, 1877-78, 1884, 1886-87, 1889-90, 1892-94, 1896-99.	Grass burning due to heat, cattle losses from grass scarcity, insufficient feed for cattle, barren lands, stock perishing for want of grass, sugar cane being used as horse feed, grass scorched with hot winds, young grass drying,	Natal Witness, 22 April 1840 KCM 98/65 FLEMING, John. Extracts from John Fleming's Diary, 1850-1891 Natal Witness 28 May 1852 USPG D8, Bishop Colenso of Natal, Maritzburg, 31 May 1856 (USPG D8, Bishop Colenso of Natal, Maritzburg, 5 October 1858) USPG D25a, Bishop Colenso of Natal, Maritzburg, 28 September 1861 Natal Witness, 19 September 1862 ABC 15.4 vol 6, Reel 177. Mission to Zulu land 1860-1871 Lindley June 6th 1863 Natal Witness, 20 July 1866 Natal Witness, 6 September 1867 Natal Witness, 7 October 1870 Natal Witness, 3 June 1870 Natal Witness, 23 February 1872 Natal Witness, 20 May 1873 Natal Witness 30 April 1874 Natal Witness, 20 August 1875 Natal Witness 2 April 1878 Natal Witness, 24 August 1878 Natal Witness, 8 October 1878 Natal Witness, 12 September 1884 Natal Witness 11 September 1886 Natal Witness, 18 September 1886 Natal Witness, 12 September 1887 Natal Witness 5 October 1889 Natal Witness, 9 October 1890
		×		1836-37, 1851, 1860, 1864, 1870, 1872-73, 1876, 1878-79, 1880, 1884-86, 1888-90, 1892, 1896-97,1900	Migrations, searching for water, implementation of municipal water regulations, fountains drying, competition of water resources,	Natal Witness, September 20 1864 Natal Witness, November 21 1890 H J Venable, ABC Film 467 Volume 2 5 Oct 1837

Region	Grass scarcity	Water scarcity	River desiccation	Documented years	Documented Impact/response	Source
			×	1845, 1856, 1866, 1874, 1876-77, 1885-1889, 1890, 1892, and 1895	Agricultural ground too dry, famine, dry springs, low levels in Tugela river, drying spruits,	USPG E20, H. Callaway, Springvale, 30 June 1866 Natal Witness 5 May 1874 USPG E32b, J.B. Jenkinson, Springvale, 31 December 1876 USPG E31, J.B. Jenkinson, Springvale, 25 March 1877 Natal Witness, 13 July 1885 Natal Witness, 14 October 1886 Natal Witness,28 January 1887 Natal Witness, 18 February 1889 Natal Witness, 21 November 1890
Lesotho	×			1837, 1844, 1851, , 1861,1863,1866, 1868, 1884, 1886-87,1895, 1897,	Landscape Changes, oxen suffered, insufficient feed for cattle, dry grass, cattle perished due to lack of food, people sending their herds away due to grass scarcity, people searching elsewhere for grass,	WMMS SA CORRESPONDENCE FBN3 Mf 107. W. Carner, Thaba Unchu, 25 September 1837 PEMS AA FBN2 Mf.83. Maeder, F. Morija. 1 Janvier 1844 PEMS AA FBN3 Mf.130. Gosselin, C. Béthesda. 10 Janvier 1851. PEMS AA FBN4 Mf.194. Lemue, P. Carmel. 28 Octobre 1861. Colony of the Cape of Good Hope (1863) Blue Book for 1862. Saul Solomon and Co., Cape Town. PEMS AA FBN4 Mf.203. Rolland, S. Béerséba. 14 Janvier 1863. PEMS AA FBN5 Mf.250. Lemue, P. Carmel. 7 Janvier 1868
		×		1832-34, 1837-38, 1851, 1862-63, 1865, 1869, 1882-83, 1887, 1890.	Migrations, searching for water, decreased fountains, lack of drinking water, lack of water for building purposes	PEMS AA FBN1 Mf.13. Lemue, P. Motito. 1er Janvier 1833 PEMS AA FBN1 Mf.17. Gosselin, C. Morija. 24 Avril 1834. PEMS AA FBN1 Mf.30. Arbousset, Th. Morija. 20 Février 1837. (District of Mokotling). PEMS AA FBN1 Mf.40. Maeder, F. Béerséba. 30 Avril 1838.

Region	Grass scarcity	Water scarcity	River desiccation	Documented years	Documented Impact/response	Source
						PEMS AA FBN3 Mf.131. Jousse, Th. Béthulie. 2 Mars 1851. PEMS AA FBN4 Mf.197 Colony of the Cape of Good Hope (1863) Blue Book for 1862. Saul Solomon and Co., Cape Town. Gosselin, C. Béthesda. 4 Janvier 1862 PEMS AA FBN4 Mf.213. Fredoux, J. Motito. 21 Juillet 1865. PEMS AA FBN5 Mf.257. Lemue, P. Carmel. 12 Janvier 1869. Widdicombe, J. (1891) Fourteen Years in Basutoland: a Sketch of African Mission Life. Church Printing Company, London PEMS LES FBN7 Mf.398. Christol, F. Hermon. Janvier 1890
			×	1834, 1838, 1840,1842, 1849, 1851, 1856, 1861-63, 1865, 1880, 1884, 1890	Rivers no longer run due to droughts, springs/fountains dried up, weak/dry springs, drought absorbs water in Caledon River,	PEMS AA FBN1 Mf.17. Gosselin, C. Morija. 24 Avril 1834. PEMS AA FBN1 Mf.14. Arbousset, Th. Morija. 28 Janvier 1834 Germond, R.C. (1967) Chronicles of Basutoland: a running commentary on the events of the years 1830-1902 by the French protestant missionaries in Southern Africa. Morija Sesuto Book Depot, Morija, Lesotho. WMMS SA CORRESPONDENCE FBN4 Mf 120, J. Cameron, Plaatberg, 21 February 1842 PEMS AA FBN3 Mf.118. Fredoux, J. Motito. 18 Février 1849. PEMS AA FBN3 Mf.131. Jousse, Th. Béthulie. 2 Mars 1851 PEMS AA FBN3 Mf.133. Pellisier, J. P. Béthulie. 15 Mai 1851 Germond, R.C. (1967) Chronicles of Basutoland: a running commentary on the events of the years 1830-1902 by the

Region	Grass scarcity	Water scarcity	River desiccation	Documented years	Documented Impact/response	Source
						French protestant missionaries in Southern Africa. Morija Sesuto Book Depot, Morija, Lesotho. 1856 p.454 PEMS AA FBN4 Mf.194. Lemue, P. Carmel. 28 October 1861 PEMS AA FBN4 Mf.196. Ellenberger, F. Béthesda. 3 Septembre 1862. PEMS AA FBN4 Mf.203. Rolland, S. Béerséba. 14 Janvier 1863 PEMS AA FBN4 Mf.213. Fredoux, J. Motito. 21 Juillet 1865. PEMS LES FBN6 Mf.313. Jousse, Th. Thaba Bosigo. 30 Septembre 1880 PEMS LES FBN6 Mf.334. Casalis, E. Morija. 9 Février. 1884 PEMS LES FBN7 Mf.398. Christol, F. Hermon. Janvier 1890.
Karoo	×			1838, 1843, 1850, and 1862	Insufficient feed for stock, lack of pastures, farmers distressed for grass, grass withering,	The Collett Diaries,7 August 1838 The Collett Diaries,31 October 1838, Cape Frontier Times, No 139 Vol3, 29 December 1843 Cape Frontier TimesNo 509 Vol10 26 February 1850 The Collett Diaries,(no date) July 1862
		×		1838, 1842, 1844, 1846-47, 1853, 1856, 1858, 1862 ,1865, and 1869	Movement of livestock to search for water, ploughing prohibited, social distress for want of water, horses suffered for water of water, crop failures, sinking of wells, retaining of rainwater (collection of water for irrigation),sheep and pasturage perished from want of water, agricultural operations at a standstill, sinking of wells on private property due to water scarcity, farmers seeking water elsewhere due to droughts, fountains drying up,	The Collett Diaries,29 September 1838 The Collett Diaries,30 September 1842 Cape Frontier Times, 1844 No190 Vol4 4 January 1844. (no date) February 1846, The Collett Diaries Cape Frontier Times, 1853 No 668 Vol16 22 March 1853 Cape Frontier Times, 1856 No 853 Vol17 14 October 1856

Region	Grass scarcity	Water scarcity	River desiccation	Documented years	Documented Impact/response	Source
						Cape of Good Hope (Colony) Blue Books. Cape Town, Richards p JJ10: Year of 1862 Appendix: Beaufort 1858 Cape of Good Hope (Colony) Blue Books. Cape Town, Richards p FF5: Observations by Civil Commissioners. 1862 Cape of Good Hope (Colony) Blue Books. Cape Town, Richards p JJ20: Year of 1862 Appendix: Cradock The Collett Diaries,(no date) November 1862 . 1865. Cape of Good Hope (Colony) Blue Books, Cape Town, Richards. P.JJ 31: Year of 1865 Appendix: Bedford Cape of Good Hope (Colony) Blue Books. Cape Town, Richards p JJ34: Year of 1869 Appendix: Cradock Cape of Good Hope (Colony) Blue Books. Cape Town, Richards p JJ9: Year of 1869 Appendix: Beaufort West
			×	1836, 1842,1845, 1849, 1850-51,1853-55, 1860,1862, 1863,	River drying up/ceased to run, river so dry as it ceased to run, river running weak,river fast drying up dams all empty pastures very dry and scanty, cultivation at a standstill,	1 January 1842, The Collett Diaries 22 December 1845, The Collett Diaries (no date) November 1850, The Collett Diaries The Collett Diaries,9 December 1850 The Collett Diaries,16 January 1854 The Collett Diaries,22 January 1855 The Collett Diaries,1 February 1855 The Collett Diaries,27 January 1860 The Collett Diaries,(no date) July 1862, The Collett Diaries,3 July 1863,
Kalahari	×			1850-51, 1871, 1882-83, 1889, 1894.	Cattle losses, fountains dried up	LMS C 25-1-B R. MoffatKuruman 28 March 1850

Region	Grass scarcity	Water scarcity	River desiccation	Documented years	Documented Impact/response	Source
						LMS C 36-3-D C. Williams Molopolole 26 May 1871 LMS C 41-3-A W. Ashton Barkly 25 January 1882 LMS C 42-1-C R.W. Thomson Shoshong 26 December 1883 LMS C 46-1-A J. Brown Taung 12 January 1889 LMS C 51-1-C R. PriceKuruman 27 May 1894
		×		1836, 1841-43, 1848-49, 1851, 1858-59, 1861-62, 1874, 1877, 1883, 1885-86, 1888, 1893, 1895, 1898.	Impact to domestic use, irrigation failures, desertification, thirst amongst indigenous people, ploughing prohibited, digging wells in search of water for cattle, less appearance of game, cattle losses, scattering of people, failure of corn crops, conflict over water resources, exploration of other routes with gettable water supplies,	LMS C 15-2-D R. Edwards Kuruman 18 July 1836 LMS C 18-2-B R. Edwards Kuruman 8 December 1841 LMS DL Box 1 D. LivingstonKuruman 22 December 1841 LMS C 20-1-B H. Helmore Lekatlong 12 December 1843 LMS DL Box 5 D. Livingstone Kolobeng (no date) November 1848 London Missionary Society (1850) Report of the Directors to the Fifty-Sixth General Meeting of the Missionary Society, usually called the London Missionary Society, on Thursday, May 9th 1850. McDowall: London. LMS DL Box 5 D. Livingstone Kolobeng 26 April 1851 LMS HHC Bessie Moffat Kuruman 25 January 1858 LMS C 31-3-B W. Sykes Bangwaketse, August 12 1859 LMS HHC H. Helmore Ku Zambezi 14 October 1859 London Missionary Society (1862) Report of the Directors to the Sixty-Eighth

Region	Grass scarcity	Water scarcity	River desiccation	Documented years	Documented Impact/response	Source
						General Meeting of the Missionary Society, usually called the London Missionary Society, on Thursday, May 15th 1862. Reed and Pardon: London LMS R Box 1 A.J. Wookey Kuruman 24 December 1873 LMS C 39-1-D J.D. Hepburn Shoshong 1 December 1877 LMS C 42-1-C R.W. Thomson Shoshong, 26 December 1883 LMS C 43-1-C A.J. Wookey Molepolole 22 July 1885 LMS C 44-1-D A.J. Wookey Molepolole 17 May 1886 LMS C 45-3-E H. Williams Molepolole 18 December 1888 LMS C 50-2-B W.C. Willoughby Palapye 7 August 1893 LMS C 52-1-C J.E. Reid Palapye 27 May 1895 LMS C 55-2-B Hilliard Kuruman 1 September 1898
			×	1843, 1848-54, 1862, 1873-74, 1893-94, 1897.	Springs / watercourses /streams drying up, fountains dry-people scattered trying to find water, river dried up canoes are being turned into wagons without wheels and drawn by oxen over the sandy road	LMS DL Box 2 D. Livingstone Kuruman 29 July 1843 LMS DL Box 5 D. Livingstone (no date) Kolobeng November 1848 Livingstone, D (1857) Missionary Travels and Researches in South Africa. London: John Murray. 687pp.(p.66 At Lake Ngami, having arrived there on 4 July 1849) Livingstone, D (1857) Missionary Travels and Researches in South Africa. London: John Murray. 687pp. LMS DL Box 1 D. Livingstone Boatlanama 30 April 1851

Region	Grass scarcity	Water scarcity	River desiccation	Documented years	Documented Impact/response	Source
						Livingstone, D (1857) Missionary Travels and Researches in South Africa. London: John Murray. 687pp. LMS C 29-1-A R. Moffat Molopo R (no date) May/June 1854 1862:McKenzie, John (1883) Day-dawn in dark places: a story of wanderings and work in Bechwanaland. London: Cassell and Company LMS R Box 1 A.J.WookeyKuruman 24 December 1873 LMS R Box 1 W. Ashton Kuruman 21 January 1874 LMS C 50-2-A A.J. Wookey To L. Ngami 1 July 1893LMS C 51-2-B A.J. Wookey Lake Ngami 15 October 1894 LMS C 54-2-C J. GoodKanye 30 October 1897

5.4.3 Famines

Famines were common occurrences during periods of drought in southern Africa. However, they were also documented during wet periods in some years. Famines were mentioned 277 times in historical documents for southern Africa during the period1830-1900 (Figure 5-10). Missionaries and travellers in southern Africa often described famines in relation to droughts, describing impacts such as food scarcity and hunger/malnutrition. Famines were also documented to have an impact on the cost and production of food due to droughts. Various references to such consequences are tabulated in Table 5-8. Major famines were documented during the 1860s, with a total count of 66. Towards the 1890s, famines were documented even more widely, with a total of 84 mentions of it occurring across Lesotho, KwaZulu-Natal and the Kalahari regions.

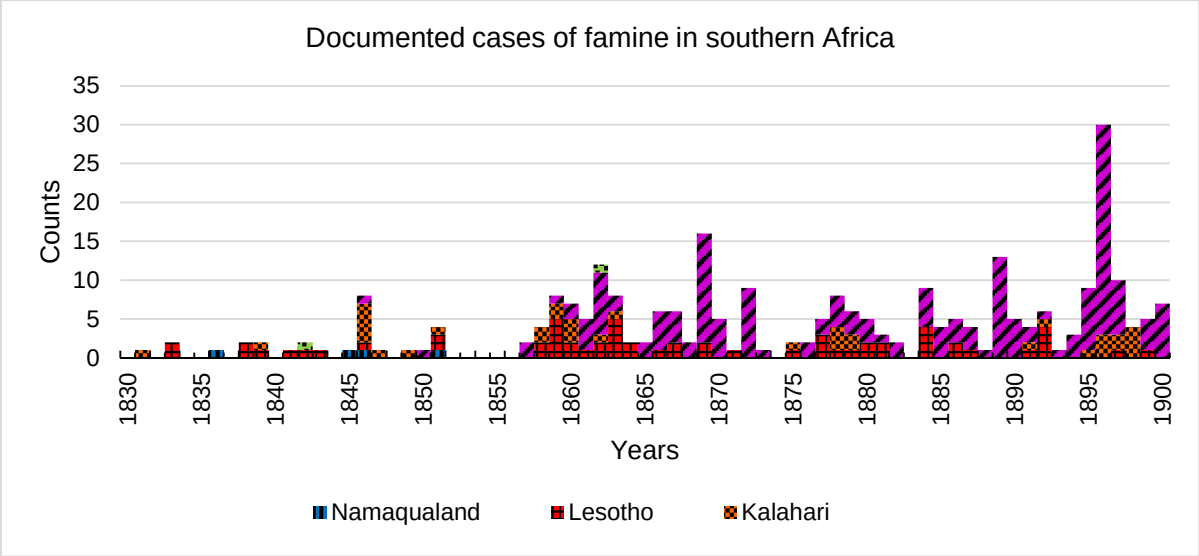


Figure 5-10: Documented famines for southern Africa during the 19th century

Famines were often described in much detail across southern Africa (Table 5-8). Such famines were often described and associated with things like “starvation”, “suffering” (Natal Witness 25 January 1860,USPG E20, H. Callaway, Springvale, 30 June 1866 “distress” (Germond, R.C. (1967) Chronicles of Basutoland: a running commentary on the events of the years 1830-1902 by the French protestant missionaries in Southern Africa. Morija Sesuto Book Depot, Morija, Lesotho) and even destitution” and “death” (LMS C 32-1-A W. Ross Lekatlong 13 January 1860).

Table 5-8: Descriptive mentions of famines associated with droughts in southern Africa

Region	Period	Quotation	Reference
KwaZulu-Natal	1860	Durban. It seems no exaggeration to say that we are approaching the starvation point in Durban. Rice, mealie meal, and flour, are all equally scarce and frightfully dear, while famine prices have become so unfortunate a reality as to form a fitting subject for declamation from the pulpit.	Natal Witness 25 January 1860
KwaZulu-Natal	1866	We are at the present time suffering from famine and I fear that before Christmas there will be very much suffering. There has been a long continued drought. The stream on which we depend for our supply of water is nearly dry. The grass burnt up and brown much more than is usual at this time of year. The cattle consequently are suffering. The greater part of the mealie crop, upon which the natives so much depend, was destroyed by the want of rain and the scorching sun, and our crop is a good average for the season, but is only half of what I reaped last year.	USPG E20, H. Callaway, Springvale, 30 June 1866
KwaZulu-Natal	1877	At the beginning of this year up to the middle of February we were suffering from severe drought. The river ceased to flow and there was a dread of famine. Mercifully, however, six weeks ago, the Lord sent a gracious rain and revived the parched country, just in time to save the maize etc. 23 Jan. Burning heat. Very dry. River stagnant above the waterfall. February 3. Thermometer at 104° under thatch, E side at 12 noon. At 4 p.m. still at 102° on the shady side. 90 in my study. 4. Still hot and dry. Fears of famine.	USPG E31, J.B. Jenkinson, Springvale, 25 March 1877
Lesotho	1842	p.442 “Unfortunately the natives are the victims of another plague, no less terrible than war. This year’s harvest has failed and a great famine is the source of acute distress among them.” Citing S. Rolland, Beerseba, August 1842).	Germond, R.C. (1967) Chronicles of Basutoland: a running commentary on the events of the years 1830-1902 by the French protestant missionaries in Southern Africa. Morija Sesuto Book Depot, Morija, Lesotho
Lesotho	1851	“The ravages of war and a long drought with other concurring causes have reduced our people to great straits and difficulties. Though not what I would call a famine, yet great scarcity of food prevails on Thaba Nchu which has forced not only many of the heathen but also a goodly number of the Christians to go elsewhere in search of the means of subsistence.”	WMMS SA CORRESPONDENCE FBN4 Mf 130. J. Cameron, Thaba Nchu, 11 January 1851
Lesotho	1861-62	p.103 “Drought was frequent and had more disastrous consequences than in these days when it is easier to bring help to the famine-stricken”.	Smith, E.W. (1996) The Mabilles of Basutoland. Facsimile Reprint of the 1939 original edition published by Hodder and

			Stoughton. Morija Museums and Archives, Morija, Lesotho
Lesotho	1884	"We are in the grips of famine because of the war and the drought".	PEMS LES FBN6 Mf.339. Weitzecker, J. Léribé. 7 Février 1884
Lesotho	1886	p.468 "The Transvaal is experiencing a fairly serious economic crisis. Besides it is well known that the prosperity of South Africa as a whole has been arrested by the three years of drought and famine which were so severely felt in Basutoland." (citing Paris, undated 1886).	Germond, R.C. (1967) Chronicles of Basutoland: a running commentary on the events of the years 1830-1902 by the French protestant missionaries in Southern Africa. Morija Sesuto Book Depot, Morija, Lesotho
Kalahari	1846	"The famine has been exceedingly severe. In the whole district around us, much distress has been among the people…"	LMS C 22-1-B W. Ross Kuruman 16 December 1846
Kalahari	1847	"…many troubles, because of the famine… scattering the people to seek for food…"	LMS C 21-1-A W. Ross Mamusa 9 April 1847
Kalahari	1860	"Up to the present date we have only had slight showers in the neighbourhood, the consequence is that large cultivated fields by our people here are without the least hope of raising any food, hence the severe famine increases and there are everywhere much destitution and death"	LMS C 32-1-A W. Ross Lekatlong 13 January 1860
Namaqualand	1836	"It is difficult to speak of the Gariep otherwise than in the most enthusiastic terms. Besides its beautiful African features, its utility is very great. To the wandering tribes dwelling near it affords an unfailing refuge in seasons of drought and famine". (Alexander, 1937, 107-108)	An Expedition of Discovery into the Interior of Africa, through the hitherto undescribed Countries of the Great Namaquas, Boschmans, and Hill Damaras. Performed under the Auspices of Her Majesty's Government, and of the Royal Geographical Society; and conducted by Sir James Edward Alexander, K.L.S., Captain in the British Service, &c. Two vols. 12mo. Pp. 302, 306. H. Colburn
Namaqualand	1851	21st, Sabbath. [Dec. 1851]. The sun had become warm when I descended the wagon. The burnt rocks, the extent of desert, the brown veld, the want of people, the dreary waste, had all in former years of drought and famine been quite familiar. (Tindall, 1959, 161).	Tindall: B.A, 1959: *The Journal of Joseph Tindall: Missionary in South West Africa 1839-1855*, The Van Riebeeck Society, Cape Town.

The initial records of famines were in the 1830s and was documented in the Kalahari region as early as 1831 (LMS C 12-4-D R. Moffat et al. Lattakoo 26 December 1831), during a dry period and in 1839 (LMS C 16-5-B R. Hamilton/R. Edwards Kuruman 6 September 1839). During this period the famine caused much hardship due to crops being destroyed by frosts

while droughts were also the cause of hunger amongst inhabitants (LMS C 16-5-B R. Hamilton/R. Edwards 2 September 1839). Documentary evidence highlights that such a year of hunger had never been experienced prior to this before in the Kalahari region (LMS C 16-5-B R. Hamilton/R. Edwards 2 September 1839).

"…*the inhabitants are now suffering from famine – not only in the neighbourhood but in countries hundreds of miles distant. They of this distant have not for years felt the ravages of hunger as at present…. Much of the corn which was preserved from the lands was cut off while not in a ripe state by a frost in March and April*…" (LMS C 16-5-B R. Hamilton/R. Edwards 2 September 1839).

Famines then started affecting people in regions such as Lesotho in the years 1833 (a very dry year) (PEMS AA FBN1 Mf.13. Lemue, P. Motito. 4 Décembre 1833); and 1838-39 (very wet years) (PEMS AA FBN1 Mf.41. Rolland, S. Béerséba. 15 Septembre 1838, Germond, R.C. (1967) Chronicles of Basutoland: a running commentary on the events of the years 1830-1902 by the French protestant missionaries in southern Africa. Morija Sesuto Book Depot, Morija, Lesotho); and once in Namaqualand during a drought year in 1836 (An Expedition of Discovery into the Interior of Africa, through the hitherto undescribed Countries of the Great Namaquas, Boschmans, and Hill Damaras. Performed under the Auspices of Her Majesty's Government, and of the Royal Geographical Society; and conducted by Sir James Edward Alexander, K.L.S., Captain in the British Service, &c. Two vols. 12mo. Pp. 302, 306. H. Colburn). The famine recorded in Lesotho during 1838 was a result of harvest failures (PEMS AA FBN1 Mf.41. Rolland, S. Béerséba. 15 Septembre 1838); while during the same year, provisions of basic essential food items were on the rise due to famine (PEMS AA FBN1 Mf.41. Rolland, S. Béerséba. 18 Juin 1838); while the impacts of famine in 1833 resulted in the disappearance of game in Lesotho (PEMS AA FBN1 Mf.13. Lemue, P. Motito. 4 Décembre 1833).

It appeared that famines were more widespread in Lesotho than the Kalahari and Namaqualand during the early 1830s, while there were no documented cases of famine happening in the Karoo and KwaZulu-Natal regions in the 1830s. Failed harvests as a result of droughts were documented in Lesotho in 1833 and exacerbated the famine crises for the region, while migration of animals in searchof food is also recorded as an impact of famine (Germond, R.C. (1967) Chronicles of Basutoland: a running commentary on the events of the years 1830-1902 by the French protestant missionaries in Southern Africa. Morija Sesuto Book Depot, Morija, Lesotho). A description of the 1833 famine in Lesotho is further highlighted in the quotation:

"During these last three months famine has caused serious devastation in this country. All the game has left us, the drought is universal" (PEMS AA FBN1 Mf.13. Lemue, P. Motito. 4 Décembre 1833).

The impact of famines was also documented to have affected the price of commodities such as flour and meat in Lesotho as described below:

"Famine is reigning everywhere. Flour is at 63 fr for a bag of 80 lb. Meat has also tripled in price, luckily we had a few old cows or ewes to kill this year, or we would have had to ask for a salary increase" (PEMS AA FBN1 Mf.41. Rolland, S. Béerséba. 18 Juin 1838).

The famine of 1838-39 in Lesotho was also a result of failed harvests and in response, indigenous people were compelled to killing cattle as a means of obtaining food, as described:

"*I have to say that they had been deprived of their harvests and the fruits of their work. The famine was making itself felt in a very alarming way and led them to make a commando unit to obtain some cattle to kill*" (PEMS AA FBN1 Mf.41. Rolland, S. Béerséba. 15 Septembre 1838).

However, in comparison to other regions, there were no mentions of interventions or coping strategies to overcome famine during the 1830s. Towards the 1840s, there were a total of 16 documented cases of famines across southern Africa. In comparison with the 1830s, there were more reported cases of famine during the 1840s. These famines were relatively spread across all regions, with the most documented cases in the Kalahari, while the Karoo had the least mentions, with one documented record of famine during the year 1842 in the Cape Frontier Times (No 134 Vol. 3,24 November 1842). Even though famine was a serious problem during periods of droughts, documentary records for the Karoo focused more on reporting things such as locusts, the general descriptions of weather and the state of rivers/streams/lakes. This however does not indicate that hunger was not considered a serious problem for the Karoo region, despite it not being reported as widely as in other regions.

The outbreak in Lesotho during 1841-42 was during very dry/drought years, while later outbreaks in 1843 and 1846 were during relatively wet years subsequent to the drought years. Namaqualand was also facing a drought in 1845 which resulted in famines being reported (The Report of the Wesleyan Methodist Missionary Society, 1846, 63), while 1846 was an unclassified year due to insufficient evidence, despite this famines were also recorded during this year (Kelso, 2010). In the year 1846, the native people in Namaqualand were also practicing livelihood changes as a means to support themselves during famine (The Report of the Wesleyan Methodist Missionary Society, 1846, 63). These changes in livelihoods included

families supporting themselves by adopting fishing as an alternate means to obtain food (The Report of the Wesleyan Methodist Missionary Society, 1846, 63).

In the Kalahari region, all documented outbreaks of famines in the 1840s were during very dry/drought years. Unlike in the Kalahari region, documented cases of famine in KwaZulu-Natal during the 1840s coincided with seasonal rains (1846). Despite the year 1846 being classified as a wet year in KwaZulu-Natal, the famine recorded in 1846 was during a spring month when rains were delayed (Natal Witness 25 September 1846). Such delayed rains were also the reason for famine (Natal Witness 25 September 1846). However, the cause of famine was also due to social unrests between petty chiefs of Clarkbury (Natal Witness 25 September 1846). Such conflicts, probably occurred due to limited resources between chiefs, were documented to be the main reason for preventing people from ploughing, such conflicts are described below:

"*The petty chiefs of Clarkbury have been fighting amongst themselves. Ummangalise and Songana have been attacked by Matuana, and have carried off eight kraals of cattle, and killed five men. I fear the whole land from one end to the other will soon be involved in war, and that there will be a fearful loss of life. At present we have famine here, and many people are living on roots. This unsettled state of things prevents them from ploughing. We have not yet had a single shower of rain*" (Natal Witness, 25 September 1846).

The dry summer in the Kalahari during 1849 was one of the contributing factors affecting produce and wheat crops which resulted in severe famine during this year (LMS C 24-1-A R. Hamilton Kuruman18 January 1849). Gardens were scorched during this period due to the intensity of the heat:

"*Last winter was mild, this summer has been very dry, the wheat crop grown and cut without being once scattered with rains since May last only three showers have fallen here and many parts of this land have got none yet, there will be a great famine this year as native gardens have been burnt up by the sun* (LMS C 24-1-A R. Hamilton Kuruman 18 January 1849).Missionaries were describing the 1849 famine in the Kalahari region as follows:

"The famine has been exceedingly severe. In the whole district around us, much distress has been among the people…" (LMS C 22-1-B W. Ross Kuruman 16 December 1846)

During the relatively dry period in 1841-42 in Lesotho, prolonged droughts and poor pastures resulted in indigenous people taking preventive measures in order to avoid famine. Although during this period famine was not reported, preemptive measures such as migration were being adopted by the indigenous people in order to seek greener pastures elsewhere (PEMS

AA FBN2 Mf.63. Pellisier, J.P. Béthulie. 1er Octobre 1841). While such measures were not being adopted in other regions, the Basotho people remained extra cautious and prepared themselves in fear of a famine occurring. However, the severity of the famine in 1842 was compared to war despite some indigenous people migrating to other areas in 1841; famine still remained a distress to many indigenous people:

p.442 "*Unfortunately the indigenous people are the victims of another plague, no less terrible than war. This year's harvest has failed and a great famine is the source of acute distress among them*." (Citing S. Rolland, Beerseba, August 1842) (Germond, R.C. (1967) Chronicles of Basutoland: a running commentary on the events of the years 1830-1902 by the French protestant missionaries in Southern Africa. Morija Sesuto Book Depot, Morija, Lesotho).

Towards the end of the 1850s and throughout the 1860s, famines were widely documented in southern Africa with a total count of 85 famine cases recorded. The affected regions reported during this period were the Kalahari, Karoo, Lesotho and KwaZulu-Natal. The famine outbreak recorded in Lesotho during the following consecutive years 1858-1862 were during a relatively dry period, while the 1863-64 famine was recorded during very wet years. The inhabitants of Lesotho are mainly pastoral and agricultural farmers and the famine of 1858 had severe consequences in this regard (PEMS AA FBN4 Mf.179. Fredoux, J. Motito. 16 Janvier 1858). This famine of 1858 was also widespread and particularly serious in Lesotho, when many indigenous people were then forced to consume wood from motlopi trees as a coping mechanism for survival:

"*The famine is very widespread this year in this country and particularly for the Battaros it appears. It is the consequence, at least in part of the death of the cattle which I have already mentioned more than once in my letters. Many people literally feed themselves with wood. In this country a sort of tree called motlopi exists, which becomes big like the oak tree. They take the root, crush it, make it undergo further preparations and then eat it*" (PEMS AA FBN4 Mf.179. Fredoux, J. Motito. 16 Janvier 1858).

The rise in famine during 1859 was also due to factors such as war, prolonged drought conditions, and diseases in Lesotho (Germond, R.C. (1967) Chronicles of Basutoland: a running commentary on the events of the years 1830-1902 by the French protestant missionaries in Southern Africa. Morija Sesuto Book Depot, Morija, Lesotho). Such factors made the famine even more difficult to overcome with food shortages and malnutrition raising the vulnerability of the population to diseases.

p.456 “*This year has been fertile in trials of every kind; a war, prolonged drought, famine, typhoid fever, such are the divine chastisements that have passed over our heads one after the other*.” (Citing Jousse, Thaba Bosiu, May 1859). (Germond, R.C. (1967) Chronicles of Basutoland: a running commentary on the events of the years 1830-1902 by the French protestant missionaries in Southern Africa. Morija Sesuto Book Depot, Morija, Lesotho).

Famines were also affecting individual livelihoods in Lesotho, particularly farmers and those described as shepherds whose primary income was derived from cultivation of fields and cattle herding (Germond, R.C. (1967) Chronicles of Basutoland: a running commentary on the events of the years 1830-1902 by the French protestant missionaries in Southern Africa. Morija Sesuto Book Depot, Morija, Lesotho, PEMS AA FBN4 Mf.184. Fredoux, J. Motito.1er Fevrier 1859).

Dreadful cattle plagues documented in the same year In Lesotho also made famine difficult to overcome.

“I will start by saying a few words of the terrible famine which has hit the whole region in which we live lately. Shepherds and farmers, the inhabitants of this region get their principle resources from their herds and the fields which they cultivate. But for the last few years, a dreadful epidemic has broken out on their cattle and made the majority perish” (PEMS AA FBN4 Mf.184. Fredoux, J. Motito. 1er Fevrier 1859).

Famines were recorded during dry years from 1860-62 (Germond, R.C. (1967) Chronicles of Basutoland: a running commentary on the events of the years 1830-1902 by the French protestant missionaries in southern Africa. Morija Sesuto Book Depot, Morija, Lesotho, mith, E.W. (1996) The Mabilles of Basutoland. Facsimile Reprint of the 1939 original edition published by Hodder and Stoughton.Morija Museums and Archives, Morija, Lesotho, PEMS AA FBN4 Mf.192. Conférence. Thaba Bossiou. 1er Juin 1861), and also recorded during normal rainfall years in Lesotho during 1866-67 (Sauer, J.W. and Theal, G.M. (1883) Basutoland Records: Copies of official documents of various kinds, accounts of travelers, &c. Vol. 3B 1865-1868. W.A. Richards and Sons, Cape Town. p.731-732 Letter from Chief Moshesh to the High Commissioner, Thaba Bosigo, 29 October 1866, WMMS SA CORRESPONDENCE FBN5 Mf 185. G. Baker, Thaba Nchu, 3 June 1867, Great Britain (1869) Dispatches from the Governor of the Cape of Good Hope and Lieut.-Governor of Natal, on the subject of the Recognition of Moshesh, Chief of the Basutos, and of his Tribe as British Subjects (23719). HMSO, London. p.21 [Memorandum from T. Shepstone, 26 August 1867), 1869 (p.141-143 Letter from the Rev. Messrs. Grand Pierre and Casalis to the Secretary of State for the Colonies, Paris, 1 June 1869) and 1871 (WMMS SA CORRESPONDENCE FBN4

Mf 146. A. Brigg, Wittebergen, 10 May 1871). Unlike Lesotho, all documented famine years (1858-60, 1862-63) in the Kalahari occurred during very dry/drought years. The 1862-63 droughts were the most widespread in the Kalahari with 1862 being a most intense dry phase and coinciding with an ENSO event (Nash and Endfield, 2002). The famine recorded during 1860 in the Kalahari resulted in deaths and destitution amongst indigenous people with extensive farming and agricultural pursuits being repressed (LMS C 32-1-A W. Ross Lekatlong 13 January 1860). During this year, population dispersion was an immediate coping mechanism to the famine and droughts in the region (LMS C 32-1-A W. Ross Lekatlong 19 October 1860). The famines in KwaZulu-Natal were recorded during the following relatively dry years: 1857, 1868-69, however specific documented coping mechanisms during 1857 indicted that the Natal government was providing famine relief for those suffering from hunger in the region. Such documented evidence for famine relief measures in KwaZulu-Natal is presented below:

"Kafirland. Famine has reached its last stage in Kafirland. The suffering is universal, and considerable numbers have perished, or are now perishing, of hunger, although as we learned from a Government Notice, 19,239 souls had entered, and been provided for within the colony, since the 1st of January last. This must be nearly one-half, or a third at least, of what remained of the native population of British Kaffraria at the end of the last war" (Natal Witness 4 December 1857).

Persistent dry conditions in KwaZulu-Natal during 1869 is further described in relation to famines for the region. The drought also threatened crops such as maize, with landscape changes being described as a result of the droughts:

"The continued heat and deficiency of rain for the past fortnight is telling seriously upon the future mealie crop. Throughout the thorn country they are almost completely burnt up. So great is the loss in some districts, something like a famine may be expected among the native tribes thereon located" (Natal Witness 28 December 1869).

The years 1859-60 in KwaZulu-Natal were years classified as seasonal rains (Klein *et a*l., 2016), while 1863 was classified as a relatively wet period following previous dry/drought years in 1861-62 (Klein *et al*., 2016) and 1865, with documented famine cases (USPG E17, J.M. Samuelson, St Paul's, Zululand, 30 December 1865). Seasonal rains were encountered during 1866-67 during which there was famine. The famine reported during 1860 in Durban resulted in starvation amongst the people and as a result of famine, staple food items such as rice, mealie meal and flour are reported to have been scarce and high in prices (Natal Witness 25 January 1860). Crop failures mentioned during 1862 were also a factor contributing towards

famine in KwaZulu-Natal, while during the same year population dispersal was also occurring as a coping mechanism, in response to famine (USPG E9a, R. Robertson, Kwamagwaza, 7 April 1862). In the Karoo region, reported cases of famine led to the increase in crime (Cape of Good Hope (Colony) Blue Books. Cape Town. Richards. P.JJ 33-34: Year of 1862 Appendix: Bedford 1862). Thefts of sheep, and other livestock were frequent due to the scarcity of food and droughts (Cape of Good Hope (Colony) Blue Books. Cape Town. Richards. P.JJ 33-34: Year of 1862 Appendix: Bedford 1862). Migration was common and persistent in KwaZulu-Natal during the 1860s as a response towards famine with accounts of it happening in several districts in Zululand (USPG D25a, Bishop McKenzie, Kwanaqua, Zululand, 26 January 1863). Trends of migration and population dispersal were a common response to famines during the 1860s in KwaZulu-Natal.

Throughout the 1870s, famines were widespread affecting the KwaZulu-Natal, Lesotho and Kalahari regions, but later during the 1880s, famines were only documented in KwaZulu-Natal and Lesotho. The impact of famines in KwaZulu-Natal during the year 1872, not only caused much distress, but amongst Zulu chiefs and the government, there appeared to be sign of political conflict:

"Poor Natal is distressed in many ways at the present – not only the prospect of famine but a chief who has a large number of well-armed men has rebelled against the Government" (USPG E28, T. Button, Clydesdale, 25 October 1873)

However, at the beginning of the 1880s in the Kalahari region missionary documents recorded and described conditions of heavy rains and swollen rivers for the region (LMS C 41-1-B W. Ashton Barkly 6 April 1881), although the summer of 1882 conditions changed drastically and severe droughts impacted on ploughing (LMS C 41-3-A W. Ashton Barkly 25 January 1882). The outlook in the Kalahari described during the 1880s pronounced a possibility of famine occurring, although famines were never mentioned (LMS C 42-1-CW. Ashton Barkly 8 November 1883).

"*We have had very little rain as yet and now it is too late to sow the native corn so that there is the prospect of a famine this year worse than the last*." (LMS C 42-1-CW. Ashton Barkly 8 November 1883).

Such descriptions of crop conditions could imply that famines occurred but were never mentioned or recorded by travellers as such. Describing crop conditions could have also implied that there were famines taking place in the Kalahari but were just described differently by missionaries during the 1880s. On the other hand, famines were more widespread and

documented widely in the 1870s and 1880s for KwaZulu-Natal. While other regions such as Lesotho and Kalahari experienced famine during this period, in KwaZulu-Natal it was documented more and appeared to be persistent. Although famine has not been documented and mentioned for the Karoo and Namaqualand regions during the 1870s and 1880s, this does not imply that it was not affecting these regions. Documented evidence illustrated for the Kalahari in 1875-76 described that the whole country was suffering from famine as a result of droughts, and in this instance regions such as the Karoo/Namaqualand, although not documented could have also been affected by famines, just not recorded extensively:

"*Kxama, on whose land they seemed to have particular design, was uneasy. The country was suffering from drought and famine*" (Agar-Hamilton, J.A.I. (1937) The Road to the North - South Africa 1852-1886. Longman: London. p.146).

In most of the documented famine years, the mentioned cases of famines often coincided with very dry/drought years and relatively dry years. The famine documented in KwaZulu-Natal during 1872 was described as extremely severe such that it led to cases of food theft (USPG E27a, J.M. Samuelson, St Pauls, Zululand, 30 September 1872). Indigenous people during this period were desperate such that they resorted to stealing of food, which could also be seen as an immediate social response to cope with famine. Such cases of theft were never mentioned in other regions. Although 1872 was classified as a relatively wet year for KwaZulu-Natal (Klein *et al.,* 2016), the region was still recovering from the previous relatively dry year. By 1872, indigenous people in KwaZulu-Natal continued to migrate as a response to famine while other means of coping with famine in KwaZulu-Natal were religious responses such as prayers for rains:

*"Daily prayer for rain. The daily congregations were never so good as now, making allowance for the 60 native Christians who left after Bp. Callaway's departure. I think the people began to dread a famine and came to pray for rain" (*USPG E33a, J.B. Jenkinson, Springvale, 25 March 1878*)*

Towards the latter 1870s, mentions of famines in Lesotho were described by missionaries in terms of the outlook due to drought conditions. This was the case in 1877 during an extremely dry period. There were descriptions implying the probability of famine should rain not come soon (Barkly, Mrs. Fanny (1894) Among Boers and Basutos. Remington, London [Letter from her husband, Arthur Barkly, Resident Magistrate of Thaba Bosigo, on his arrival at Advance Post, Basutoland, dated 1 October 1877]). Although famine was not recorded as such, the region was experiencing much distress, crop failures and war during these years 1877-78, which exacerbated the possibility of a famine from occurring:

Everything seemed to oppose itself to our return to work: The illness of my dear companion, the war, the drought (Speaking of the drought)…..This one had made itself felt for ten months now. The heat was excessive, all along our route pastures were lacking, the torrents and rivers were completely dry. Also, you will not be surprised if I told you that there were such a large number of dead oxen along the road that we gave up counting them (PEMS LES FBN6 Mf.301. Ellenberger, F. Siloé. 18 Février 1878).

An immediate coping mechanism in Lesotho was prayer for the above mentioned turmoil's and troubles, this is described as such:

*"On the 7th all in the Colony had gathered to pray for 3 things: the end of the war, rain and for hunger to be overcome" (*Leselinyana La Lesotho 1 Hlakubele/March 1878).

By the 1880s, Lesotho was described as a desert due to population dispersion, war and famine (Great Britain (1881a) Correspondence respecting the Affairs of Basutoland [C.-2821]. HMSO, Londonp.72 [Letter from E. Casalis to Colonial Office, 9 December 1880]. By 1881, missionaries recorded that the region recovered from the famine and it almost disappeared with some wheat being harvested (PEMS LES FBN6 Mf.318. Germond, P. Th. Morena. 17 Février 1881), but the famine of 1880, still had a huge impact on prices and scarcity of food (WMMS SA CORRESPONDENCE FBN6 Mf 205. J. Daniel, Thaba Nchu, 22 April 1881). Although the region was described as being clear of famine, there was still distress being felt with many inhabitants having already migrated in search for work and food. By 1884, those inhabitants who were unable to migrate had already died from hunger due to widespread droughts felt across southern Africa:
p.466 "*Through the letters of our missionaries we receive distressing particulars concerning the drought and famine which are raging in some parts of Basutoland. Mr. Ellenberger writes of us that 'many people have already died of hunger'; he adds 'if the rains delay, the desolation will be great'* (Germond, R.C. (1967) Chronicles of Basutoland: a running commentary on the events of the years 1830-1902 by the French protestant missionaries in Southern Africa. Morija Sesuto Book Depot, Morija, Lesotho).

Exchange of cattle was a form of coping with famine in KwaZulu-Natal. Such a coping mechanism was not recorded to have taken place in other regions. Those inhabitants who had cattle were able to exchange their cattle for food during the 1884 famine (USPG E39b, C. Johnson, St Augustine's, Zululand, 31 December 1884). Livestock represents livelihood, income and employment, and the importance of livestock is crucial during droughts in southern Africa as it is used as a form of bartering to secure food during famine. Cattle exchanges

during droughts were therefore an immediate coping mechanism in regions such as KwaZulu-Natal to allow indigenous people to trade what they owned for other staple articles such as grain or vegetables.

By the 1890s, famines were widespread and documented often for KwaZulu-Natal. By 1896, famine relief was supplied by the government of KwaZulu-Natal (Natal Witness 19 October 1897). These findings are also consistent with those found by Nash *et a*l. (2015) which described the initiation of famine relief measures in KwaZulu-Natal during 1896.The relatively dry conditions for KwaZulu-Natal during 1896-1897 were also combined with impacts of locust invasions, and rinderpest amongst cattle (Nash *et al*., 2015). The Natal government obtained large supplies of maize and issued them to native families at cost price in various districts in KwaZulu-Natal. The famine described in the Natal Witness in 1896 was quoted from a private letter received from Durban. It caused much hardship during this year with prices of food increasing; other factors such as locusts were also described to be amongst the issues depleting the state of the people's resources in Natal:

"*We (Mercury) have been Permitted to copy the following extract from a private letter received in Durban from Etataneni near Eschowe: - "Famine sore in the land. Many who have kept up until now beginning to feel it much. One family I know slept last night without cooking. Mealies are 35 shillings per muid at the stores in this district. What with locusts, quarantine, and other things, life is not easy just now in this poor country*." (Natal Witness 10 December 1896).

5.4.4 Economic impact of famines in the 19th century

The major drought periods in southern Africa had serious implications for food security as well as on the cost of food. Famine prices for southern Africa were analyzed and are discussed in terms of cost of commodities, high prices of basic provisions, affordability and food prices. From interpretation of the source material, famine prices were often a term used to describe a year in which food became expensive, mainly when there was a period of drought or when harvest outputs were poor or below average. Crop failures as a result of drought conditions were regarded as a main factor contributing to famine prices. If crop production was low, then food would have to be imported to meet the dietary needs of people. In addition, other factors could have contributed to high food prices, such as the introduction of grain taxes, and importation of cheap grains from other highly capitalized agricultural countries such as America and Australia (Mokitimi, 1990). Of the famine prices that were documented, Lesotho appeared to have the most documented cases (33%, a total count of 22), whilst the Karoo displayed 21%, a total count of 14 mentions of famine prices and KwaZulu-Natal displayed 29% of documented cases (a total of 19 counts) of famine prices (Figure 5-11). Livelihoods of

the Basotho people were dependent on crop production, pastoralism, hunting, and gathering of wild, edible plants. The Basotho also engaged in trade activities with communities such as the Nguni in modern day KwaZulu-Natal and Eastern Cape areas of South Africa (Maliehe, 2014). In addition, the Basotho often traded household utensils made from iron and copper, iron hoes, animal skins, tobacco and commodities (Maliehe, 2014). In regions such as Namaqualand, there was a significant asset for the livelihoods of the Namaqua people on which their livelihoods depended on for activities such as mixed and stock farming (Price, 1976). The basis of the economy in the Kalahari and Karoo regions is centred on cattle herding practices and pastoral activities (Silberbauer and Logan, 2017). In times of drought, the impacts were devastating to food security, leading to famine, hunger, deprivation of food supplies, low harvest yields, and increase in provisions. Such consequences had serious implications on the livelihoods of the people of southern Africa. In addition, due to droughts, local markets were badly supplied with food and imported food could be the reason for such high demand in food prices (Cape of Good Hope (Colony) Blue Books, Cape Town, Richards. P.JJ23: year of 1862, Appendix, Graaff-Reinet).

The earliest mention of famine prices were documented and recorded in Lesotho in 1838, a year classified as very wet. Although 1838 was classified as a very wet year, the region was still recovering from an earlier drought. A consequence of the extreme drought resulted in food being extremely expensive during 1838 (PEMS AA FBN1 Mf.40. Maeder, F. Béersébа. 30 Avril 1838). Famine prices were not mentioned or recorded until 13 years later in KwaZulu-Natal. During this year although it was classified as a relatively wet period, reference made to a relatively dry 1849 indicated that the prices of maize increased as a result of the 1849 drought. Such documented evidence also makes reference to the inflated prices of maize as described in the quotation below reported by the Natal Witness:

"The recent drought threatens to raise mealies to a high price shortly. At present a few loads are brought into town by wagons sent out for the purpose, usual supplies carried in by troops of indigenous people in baskets, having very materially diminished. The present price at Pietermaritzburg is from 12s. to 15s. per muid" (Natal Witness 12 April 1850*).*

Towards the 1850s and some years during the 1860s, famine prices were more widespread with the effects of it now being felt across the Karoo, Lesotho and KwaZulu-Natal. Of these years, 1859 was a relatively dry year in Lesotho, with a prolonged drought affecting agricultural pursuits in the region (Theal, G.M. (1908) History of South Africa since September 1795, Vol. 3. Swan Sonnenschein & Co., London). Famine prices recorded in KwaZulu-Natal during 1860 resulted in indigenous people reaching a point of starvation from not being able to purchase basic provisions such as rice, mealie meal and flour at famine prices (Natal Witness 25

January 1861). However, by November 1861, the region recovered from such famine, and the change of season which brought about good output of crops:

"Since the departure of the last mail our career has been unchecked by any stirring incidents. The principal topic and cause of alarm has been the protracted drought, the fear of the continuance of which had driven produce and food of every description up to famine prices. Happily this season has changed, and the country is smiling under the refreshing copious showers usual at this season of the year. All apprehension of dearth and famine, and the farmer and citizen are both rejoicing in the prospect of good crops and days of painting" (Natal Witness 29 November 1861).

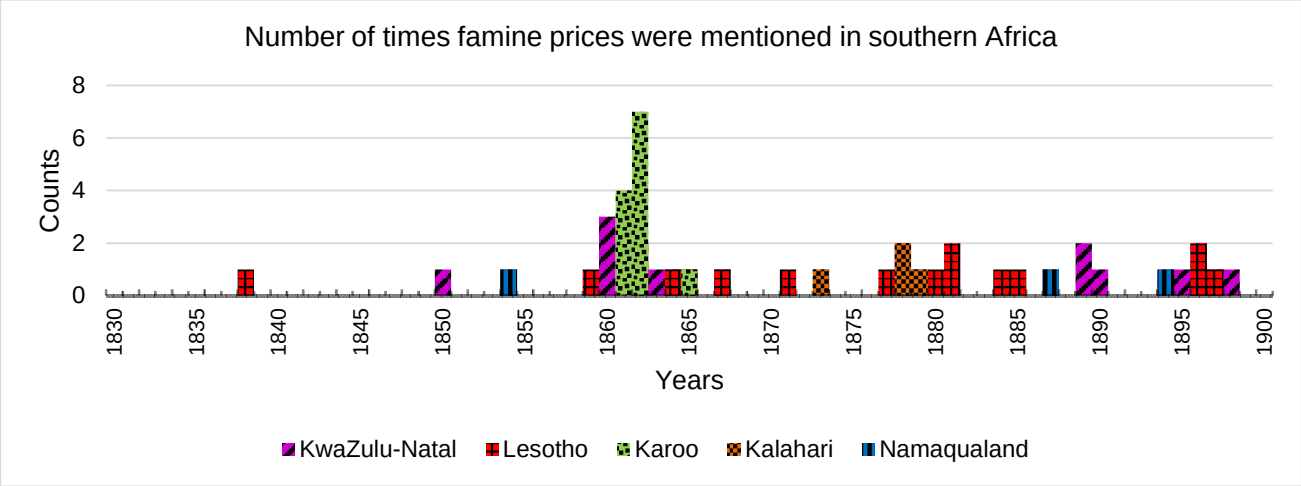


Figure 5-11: Documented cases of famine prices in southern Africa (1830-1900)

Some of the descriptive mentions of famine prices in relation to droughts for the various regions are presented in Table 5-9. Such descriptions also indicate the level of impacts that such droughts had in relation to high food prices.

Table 5-9: Descriptive mentions of famine prices due to droughts for the 19th century southern Africa

Region	Period	Quotation	Reference
Lesotho	1838	Famine is reigning everywhere. Flour is at 63 for a bag of 80 lb. Meat has also tripled in price, luckily we had a few old cows or ewes to kill this year, or we would have had to ask for a salary increase	PEMS AA FBN1 Mf.41. Rolland, S. Béerséba. 18 Juin 1838.
Lesotho	1854	p.168 [Describing drought in the Cape Colony] "In 1859 drought of unusual severity prevailed in the greater part of the colony, and in the eastern districts especially was so prolonged that even traffic in many places was suspended and agricultural industry entirely ceased… Later in the summer fine showers fell in some parts, but in many places there were	Theal, G.M. (1908) History of South Africa since September 1795, Vol. 3. Swan Sonnenschein & Co., London.

		no crops that year, and food rose to very high prices	
Lesotho	1859	"In 1859 drought of unusual severity prevailed in the greater part of the colony, and in the eastern districts especially was so prolonged that even traffic in many places was suspended and agricultural industry entirely ceased… Later in the summer fine showers fell in some parts, but in many places there were no crops that year, and food rose to very high prices."	Theal, G.M. (1908) History of South Africa since September 1795, Vol. 3. Swan Sonnenschein & Co., London
Lesotho	1871	"…the terrible drought of 1862 set in… Provisions had reached famine prices"	WMMS SA CORRESPONDENCE FBN4 Mf 146. A. Brigg, Wittebergen, 10 May 1871
Lesotho	1884	"The drought of this year has not only raised the price of grain to three times what it was when you were here, but it has deprived us of almost all vegetables".	PEMS LES FBN6 Mf.335. Dyke, R. H. Morija. 29th January 1884
Lesotho	1887	"There is no rain. Crops have died and the price of food in shops is very high".	Leselinyana La Lesotho *Vol 3 (Hlakubele/March 1887)*
KwaZulu-Natal	1860	"It seems no exaggeration to say that we are approaching the starvation point in Durban. Rice, mealie meal, and flour, are all equally scarce and frightfully dear, while famine prices have become so unfortunate a reality as to form a fitting subject for declamation from the pulpit".	Natal Witness, 25 January 1861
KwaZulu-Natal	1861	"Fears are beginning to be entertained that the absence of the usual rains at this season year, will prevent farmers planting their autumn crops of forage, potatoes, etc. Unless we are favoured with rain before long, these articles will probably rise to famine prices during the winter months. This has been the driest season known for many years past".	Natal Witness, 29 November 1861
KwaZulu-Natal	1878	"The beginning of the quarter was marked by intense drought so that we had almost famine as well as war prices. Rain used to fall in August but in November I wrote: "Dearth and scarcity even now appear to be inevitable our Bp. tells us. Men who have lived here 38 years say they never remember such a drought. The river is stagnant. The river pools drying up. There is no grass. Trees are dying and dead. The sweet potato is the only vegetable we can keep alive".	USPG E33a, J.B. Jenkinson, Springvale, 31 December 1878
KwaZulu-Natal	1879	In asking for a renewal of the grant, I would fain plead for an increase, if it is within the means of the Society, for while in the case of the clergy ministering to Colonists especially, we have cut down their incomes so low that in these days of famine and war prices it is almost impossible for them to maintain themselves	USPG D50a, W.Kenneth, Maritzburg, 20 January 1879

Kalahari	1873	"This is a good time of the year that Mr Good is coming up, but both in the Colony and in these parts it is unusually dry; consequently the oxen are very poor, and very dear and very apt to succumb on the road; which others will have to be purchased have been at almost famine prices".	LMS C 37-2-A W. Ashton Kuruman 12 November 1873
Karoo	1861	Colesburg: "The drought of the last two years has almost put a stop to agricultural operations, there has been hardly any production and all vegetable produce is sold at enormous prices. Only a few places, where the springs are very powerful, can anything be grown".	Cape of Good Hope (Colony) Blue Books, Cape Town, Richards. P.JJ 30: year of 1861, Appendix: Observations by Civil Commissioners
Karoo	1862	Colesburg: "The drought of the last three years has almost put a stop to agricultural operations. All cereals and other vegetable productions fetch enormous prices: oat hay has been selling at from 4½ .to 6d. per lb., and meal for some time at upwards of £6 per muid".	Cape of Good Hope (Colony) Blue Books, Cape Town, Richards. P.JJ 47-48: year of 1862, Appendix: Observations by Civil Commissioners

High commodity prices for individual crops/grains were often a result of droughts and famine (Table 5-10). Documented cases of bread, which formed part of the staple diet of many native populations, went above the usual prices in the Kalahari during the year 1878 recorded as a major dry period (LMS C 39-3-D W. Ashton Barkly 31 December 1878). Harvest yields were also reported to have been low and this was attributed to the little rain received during the 1878 rainy season. Missionaries in the Kalahari also reported that Natal may also experience the same hardships of increasing prices, indicating that the droughts were becoming widespread and the impacts started to expand regionally. This is further elaborated in the description below:

"We depend mostly for provisions on the Transvaal district, which is still involved in war, there is every probability that Natal will soon be in the same position, so that the bread-stuffs will be diverted from this province and consequently tho' they are now 200% above the usual price, the probability is they will become still dearer before the next harvest; for as yet we have had very little rain this season" (LMS C 39-3-D W. Ashton Barkly 31 December 1878).

Similarly, in the Karoo during 1862, bread and other necessary provisions ruled at high prices, and as a means of intervention, the Karoo division would become dependent on other regions for bread and essential consumables (Cape of Good Hope (Colony) Blue Books, Cape Town, Richards. P.JJ 22-23: year of 1862, *Appendix: Richmond*). Crop failures described and documented for the Karoo region in 1861 also impacted on inflation, as shown below:

"*In many parts the crops have altogether failed from the same cause and the prices of necessaries of life have risen very high*" (Cape of Good Hope (Colony) Blue Books, Cape Town, Richards p.JJ 25: Year of 1861 *Appendix: Richmond*).

However, despite religious responses taking place earlier in the year of 1878, famine and impacts of drought persisted in KwaZulu-Natal. The delayed rains reported in October described the impacts of famine on the prices of food as well as the fact that older inhabitants had never remembered the drought to be as bad as it was reported for the year 1878, as indicated in the quotation below:

"The beginning of the quarter was marked by intense drought so that we had almost famine as well as war prices. Rain used to fall in August but in November I wrote: "Dearth and scarcity even now appear to be inevitable our Bp. tells us. Men who have lived here 38 years say they never remember such a drought. The river is stagnant. The river pools drying up. There is no grass. Trees are dying and dead. The sweet potato is the only vegetable we can keep alive." (USPG E33a, J.B. Jenkinson, Springvale, 31 December 1878).

5.4.4.1 Droughts affecting commodity prices

The main factor affecting commodity prices during the 19th century in southern Africa were droughts, crop failures and famine. In one case lung sickness affected the price of draught oxen for KwaZulu-Natal in 1860 (Natal Witness 17 August 1860). While droughts and famine were affecting the prices of grain, cattle meat, flour, crops/vegetables, and firewood in Lesotho, Namaqualand was facing inflation on wheat, chaff, oat sheaves, rye, oats and forage in the documented year 1894, while during 1856 forage was described as being 'unprocurable' (Cape Archives Source: AGR, Volume: 57, Date: 3 February 1894 "Harvest Report" and "Agricultural prospects from September). Both of these years were classified as drought years for Namaqualand (Kelso, 2010). Wheat was also one of the earliest, dominant crops introduced in Namaqualand so droughts had a great impact on wheat production in the region (Kelso, 2010).

Documented evidence for the Kalahari revealed high bread prices as a result of droughts and conflicts in 1878 during a major dry period (LMS C 39-3-D W. Ashton Barkly 31 December 1878).

"*We are sorry to hear of the Director's 'anxiety as to the results of the Society's financial year' more especially as provisions in this country are almost at famine prices, no consequence of the long, continued droughts and on account of the war which has been raging around us. We depend mostly for provisions on the Transvaal district, which is still involved in war, there is*

every probability that Natal will soon be in the same position, so that the bread-stuffs will be diverted from this province and consequently tho' they are now 200% above the usual price, the probability is they will become still dearer before the next harvest; for as yet we have had very little rain this season" (USPG E33a, J.B. Jenkinson, Springvale, 31 December 1878).

In 1879, both Kalahari and Lesotho grain prices were also documented to be high, with indigenous people illustrating that they would have to pay famine prices as indicated for the Kalahari region:

"*We have to pay famine prices for grain and the indigenous people will have to suffer great hunger for another year this being the third of severe droughts*." (LMS C 40-2-A W. Ashton Barkly 26 December 1879).

While droughts reported in the Karoo were a main factor affecting various articles of staple foods such as wheat, barley, oat hay, cereals, bread, wool, fruit, vegetables, crops and flour, this had a huge economic blow to the local economy in the Karoo region. The rising prices of essential food articles and grains meant that public markets were also in competition to sell their grains/stock. A quote from the Cape of Good Hope (Colony) Blue Books describing the failure of wheat crops and the impact of rising prices are further described below:

"*The wheat crops of 1863 have entirely failed with a very few exceptions and meal has been selling on the public market at 42s per 100lbs a price heretofore unknown. Grain of every kind has been selling at exceptionally high rates*" (Cape of Good Hope (Colony) Blue Books. Cape Town, Richards. P.JJ 20: Year of 1862 *Appendix: Cradock*).

The Karoo region also experienced major droughts during the end of the 1850s. Documentary evidence made reference to these droughts, particularly in 1861. (Cape of Good Hope (Colony) Blue Books. Cape Town, Richards. P.JJ 25: Year of 1861 *Appendix: Richmond*). These previous droughts of the past two years had an impact on agricultural operations which resulted in vegetables being sold at higher prices due to scarcity. A relevant description in this regard indicates such evidence of this happening in 1861:

"The drought of the last two years has almost put a stop to agricultural operations, there has been hardly any production and all vegetable produce sold at enormous prices. Only a few places where the springs are powerful anything can be grown" (Cape of Good Hope (Colony) Blue Books. Cape Town, Richards. P.JJ 30: Year of 1861 *Appendix: Observations by Civil Commissioners*).

Droughts were also affecting the prices of maize, forage, vegetables and flour in KwaZulu-Natal (Natal Witness 18 August 1899). Rising prices of particular articles such as maize and forage were described to be increasing on a daily basis; this is further described as follows:

"*Newcastle. The continue drought here is causing price of mealies and forage to rise almost daily*" (Natal Witness 18 August 1889).

The production of crops in Lesotho remains one of the most important agricultural activities in the region (Mokitimi, 1990), grains production takes up much time in terms of land use and time committed to production. As noted from Table 5-6, droughts and famine affected seeds and grains drastically, only in Lesotho during these years: the 1863-64 very wet years; the 1877-78 very dry years; the 1879-80 relatively dry years; the very dry period in 1884; and with 1889 and 1896 both classified as relatively dry years (Grab and Nash, 2010). Lesotho experienced a severe, widespread drought documented in the years 1862-1863 (WMMS SA CORRESPONDENCE FBN14 Mf 527. A. Brigg, Wittebergen, 3 August 1862). The drought of 1862 resulted in delayed agricultural operations, with the "grounds being too hard to plough" (WMMS SA CORRESPONDENCE FBN14 Mf 527. A. Brigg, Wittebergen, 3 August 1862). The delay in sowing was documented to cause a famine in the region, while simultaneously the prices of corn was double than that of the previous year (WMMS SA CORRESPONDENCE FBN14 Mf 527. A. Brigg, Wittebergen, 3 August 1862). During the years 1863-1864, Lesotho appeared to be still recovering from this drought even though it was a very wet year with widespread summer rains, the Basotho's remain hopeful that the price of provisions and seeds will become cheaper and that indigenous people will have a year of rich harvests (PEMS AA FBN4 Mf.208. Maeder, F. Siloé. 15 Janvier 1864). The prices of seeds of all sorts of food were reported to be very costly in this year, indicating that the region was still recovering from a famine:

"*Seeds of all sorts of food were extremely expensive and are still now, but nothing prevents us from hoping that they will become cheaper*" (PEMS AA FBN4 Mf.208. Maeder, F. Siloé. 15 Janvier 1864).

During a severe famine in Lesotho during 1838, the price of food supplies such as cattle meat and flour increased in price (PEMS AA FBN1 Mf.41. Rolland, S. Béerséba. 18 Juin 1838). While the Basotho's remained hopeful in that they responded by killing off their old cattle as a means of obtaining cattle meat for consumption. This is viewed as a miscellaneous response to avoid paying high prices for essential provisions: *"Famine is reigning everywhere. Flour is at 63 fr for a bag of 80 lb. Meat has also tripled in price, luckily we had a few old cows or ewes*

to kill this year, or we would have had to ask for a salary increase"(PEMS AA FBN1 Mf.41. Rolland, S. Béerséba. 18 Juin 1838).

The drought described in 1884 in Lesotho also affected the price of grain to three times its original prices, this is indicated as such:

"*The drought of this year has not only raised the price of grain to three times what it was when you were here, but it has deprived us of almost all vegetables*" (PEMS LES FBN6 Mf.335. Dyke, R. H. Morija. 29th January 1884). The relatively dry period during 1895-96 coupled with locust outbreaks could have also affected the prices of grains during these years, such is described in the Annual report for Leribe as follows:

"*Crops have been poor and prices of grain are still high… vast swarms of locusts appeared in the autumn. These locusts were caught by the frost before they were full grown*" (Annual Report – Leribe District for the year 1895-1896).

Towards the end of the century (1899), despite it being classified as a very dry/drought year, KwaZulu-Natal experienced a drop in price of commodities including potatoes (Natal Witness 8 February 1899). The drop in the price of potatoes was attributed to a good quantity of potatoes that were reaped during 1898 (Malcolm, Umzumbe Home [school], report for the year ending 30.6.1898, Harvard, Houghton Library, ABC 15.4, vol. 13, Southern Africa, Zulu Mission 1890-99). A good harvest during 1898 meant that the quantity of potatoes were sufficient to sustain the population.

Table 5-10: **Documented factors relating to high commodity prices**

Commodities	Lesotho	Namaqualand	Kalahari	Karoo	KwaZulu-Natal	Year	Documented Factors Contributing to high prices
Seeds/Grain/	×					1863, 1864,1877, 1878, 1879, 1880,1884, 1889, 1896	Drought, famine, food shortages, locust outbreaks
			×			1879	Drought
Chaff		×				1894	Droughts/Crop failure
Oatsheaves		×				1894	Droughts/Crop failure
Rye		×				1894	Droughts/Crop failure

Oats		×				1894	Droughts/Crop failure
Wheat		×				1894	Drought
				×		1862	Drought, crop failures
Draught cattle					×	1860	Drought, Lung sickness
Barley				×		1865	Drought
Forage					×	1885, 1889	Drought
		×				1856	Drought
Oat Hay				×		1862	Drought
Cereals				×		1862	Drought
Bread			×			1878	Drought, war
				×		1865	Drought
Wool				×		1861	Drought
Maize					×	1850,1861, 1882, 1885, 1889, 1894 and 1896	Drought , Famine, bad crops
Cattle/Meat	×					1838	Drought , Famine
Dried fruit				×		1861, 1864	Drought
Vegetables				×		1861	Drought
					×	1863	Drought
Flour	×					1838	Drought , Famine
					×	1879	Drought
				×		1862	
Crops Imported Corn	×					1862,1878, 1879	Drought
				×		1861, 1862	Drought
					×	1856, 1869, 1894	Drought
					×	1867, 1879, 1895	Drought
Firewood	×					1854	Drought
					×	1897	

Measured rainfall indicated below described the dry grounds, although mealie crops were prospering all around:

"The rainfall for the last week has only been 0.18 of an inch, and the ground is getting very dry on the top. It has been good weather for killing weeds. Mealies are reported to be doing well

everywhere. Potatoes appear to be giving good crops, and prices have dropped accordingly" (Natal Witness 1 February 1899).

During the 19th century, majority of economic impacts were a result of droughts. In addition, it was observed that the droughts were a major factor which contributed toward the decline in agricultural yields in southern Africa.

5.5 Livestock diseases

Common livestock diseases which were documented to have occurred during the 19th century were mainly lung sickness (CBPP) amongst cattle, rinderpest and African horse sickness (AHS). A total count of 202 references of such diseases, were recorded during the 19th century. Of the 202 mentions, 120 of these (59%) comprised rinderpest outbreaks across all regions during the 19th century, while lung sicknesses accounted for 27% (a total count of 54) and horse sicknesses which were not as widespread, accounted for 14% (28 counts) (Figure 5-12).

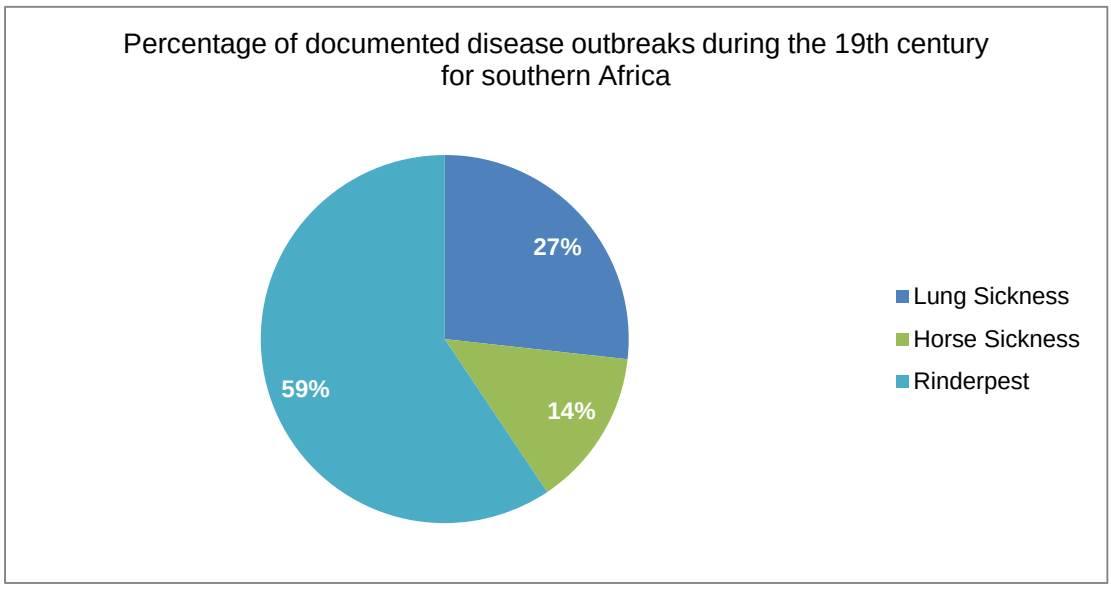


Figure 5-12: Percentage of livestock diseases documented for southern Africa 1830-1900

5.5.1 Lung sickness

The total documented count of lung sickness in southern Africa was 54. Lung sicknesses were a widespread occurrence in KwaZulu-Natal during the 19th century. A total of 38 documented cases of the lung sicknesses were recorded in this region, whilst seven documented cases were recorded in Namaqualand. The earliest documented case of lung sickness was in 1853 in the KwaZulu-Natal region, although the literature by Peires (1987), Thiaucourt (2004) and Amanfu (2009) all argue that lung sickness appeared in the Cape during 1853, this could have been the case when the disease spread from the Cape alongside trade routes (Thiaucourt,

2004) with KwaZulu-Natal marked as one of the earliest provinces in which the disease spread to.Towards the years 1855 and 1856, the appearance of lung sickness peaked throughout all regions except Lesotho, with the most documented cases presented in KwaZulu-Natal. The years 1855-56 were classified as relatively wet for KwaZulu-Natal (Klein *et al*., 2016), while Namaqualand experienced consecutive droughts during these years (Kelso, 2010), the Kalahari was unclassified (Nash and Endfield, 2002) and the Karoo region was classified as relatively wet (Lupini, 2015). Given that some of the regions experienced lung sicknesses during relatively wet periods, could also imply that infected cattle made their way into regions with water availability during these years, which could have spread the disease to regions that were not facing a drought. These findings coincide with that by Amanfu (2009), indicating that changing environmental conditions including the availability of water and grazing lands leads to increased cattle movements over long distances.

The earliest reported impact of lung sickness recorded by missionaries in KwaZulu-Natal indicated that the presence of CBPP in 1855 destroyed many cattle belonging to the mission and as a result of this the property values of the mission have also depreciated (Wilders, Annual Tabular View 1856 Harvard, Houghton Library, ABC 15.4, vol. 4, (A 467, 175, 10) Southern Africa, Zulu Mission 1847-59).

"*Many cattle belonging to the mission have been destroyed the past year by the "Lung Sickness" – thus reducing the aggregate value of mission property of that kind*". (Wilders, Annual Tabular View 1856 Harvard, Houghton Library, ABC 15.4, vol. 4, (A 467, 175, 10) Southern Africa, Zulu Mission 1847-59).

Such early accounts of lung sickness recorded in KwaZulu-Natal were introduced and spread by white traders that came into Natal and Zululand during the 19th century (Ballard, 1983).

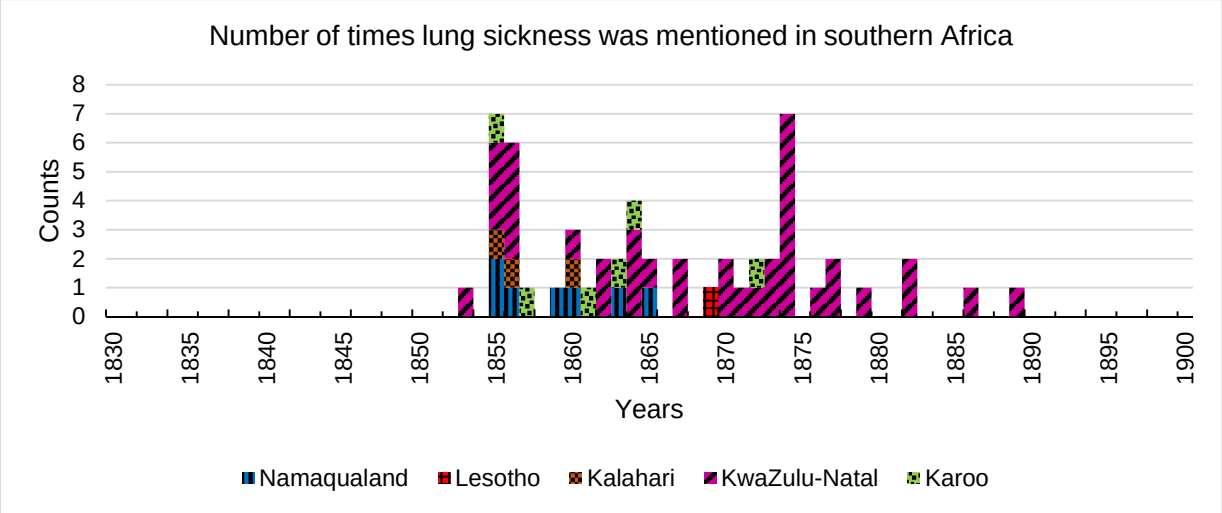


Figure 5-13: Number of lung sickness outbreaks reported across southern Africa during the 19th century from documentary sources

However, following the first reported outbreak in southern Africa, lung sickness spread rapidly across other regions (Tami *et al.,* 2006). This trend is similar to that presented for the 19th century, as documented evidence (Figure 5-13) shows the increase in documented counts of lung sickness for the Karoo, Namaqualand and the Kalahari during 1855. The spread of CBPP into the 1860s resulted in major cattle losses which had an effect on transportation, and mules began replacing oxen during this period in Namaqualand as a means of coping with the disease:

"*When the Cape Copper Mining Company started operation cattle were plentiful in the district. Then came some drought years, and this setback was compounded by lung sickness, from which hundreds of trek oxen died. Mules had proved more suitable than oxen, particularly over the mountain sections, and a span of mules numbered eight while a span of oxen varied between twelve and sixteen. An ox wagon would take six days from Okiep to Hondeklip Bay and four days on the return journey: a mule wagon would take eight days. Water along the riding routes was scarce and brack*" (Hall in Ross, 1996, C.132).

According to the findings by Kelso (2010), the outbreaks of lung sickness during 1860 in Namaqualand further affected cattle numbers in the region, while cattle that were used for transport riding were severely affected because of the disease having greater exposure due to cattle movements. Several cattle losses due to droughts and lung sickness were also described by the Civil Commissioner's Report (1865) for Namaqualand. This report highlighted that cattle losses due to lung sicknesses were destructive and made carriage of copper very unprofitable, which had an impact on copper trade (Civil Commissioner Report, 1865). This also implies the economic impact of the disease on mining regions such as Namaqualand proved fatal to the local economy of the region. Such findings also related to the literature by Tambi *et al*. (2006), which describes the economic importance of CBPP. The disease is reported to have economic consequences and impacting on trade, which coincides with the findings of this research.

A general annual letter by missionary William Ireland in KwaZulu-Natal documented the effect of lung sickness on cattle and the effect of the disease on milk production which formed a very important part of the Zulu diet (Ireland, General annual letter, 27.5.1880 Harvard, Houghton Library, ABC 15.4, vol. 8, (A 467, 181, 27) Southern Africa, Zulu Mission 1869-80). Widespread cattle losses were also devastating the local people and as was the case in Namaqualand, the effect on transportation was devastating for the KwaZulu-Natal region, particularly in Zululand (Grout, Aldin, Umvoti, letter, 26 August 1856 Harvard, Houghton Library, ABC 15.4, vol. 4, (A 467, 175, 220) Southern Africa, Zulu Mission 1847-59). Although

there has not been any documented evidence in KwaZulu-Natal indicating measures to overcome the impact on transportation, a key miscellaneous intervention proposed which had been reported in the Natal Witness (17 August 1860) was the need for considering the construction of a railway between the city and the port to overcome challenges such as high prices for draught cattle, increased traffic and lung sickness impacting oxen that were needed for transportation (Natal Witness 17 August 1860). Further impacts of lung sickness in KwaZulu-Natal resulted in cattle deaths by the thousands, and provisions such as milk*:*

"First in the order of time, among these influential causes, was the sudden and wide-spread appearance in the country, of a disease among the cattle known as pleura-Neumonia, commonly called, lung-sickness. The cattle of the Natives as well as Europeans, died by thousands, and thus the people were deprived for years, to a very considerable extent of milk, which had previously formed an important article of their daily food" (Harvard, Houghton Library, ABC 15.4, vol. 8, Southern Africa, Zulu Mission 1869-80).

Drought conditions in Namaqualand during 1855-56 were further responsible for the spread of CBPP, as people engaged in transhumance practices and moved with their cattle herds in search of water and food elsewhere (Extract of a Letter from the Rev. Richard Ridgill, dated Nisbett-Bath, March 13th, 1856.Missionary Notices, 1856, 164). Such accounts of this were described in Namaqualand during 1856:

[Arrived at Nisbett-Bath on the 21st of November, 1855]. "*I found a few families residing on the station, and the number has since decreased. A drought of twelve months' continuance dispersed the people through the length and breadth of the land in search of water and pasturage for their flocks and herds. The lung-sickness, which had proved so fatal among cattle throughout South Africa, made its appearance here simultaneously with my arrival, and spread a panic through the country. Plentiful rains have just fallen; but those who would have returned to the station are afraid to do so during the prevalence of this destruction epidemic*" (Extract of a Letter from the Rev. Richard Ridgill, dated Nisbett-Bath, March 13th, 1856.Missionary Notices, 1856, 164).

Although such transhumance practices and pastoral nomadism were vital for survival of people and their livestock, it also posed a risk as human movement created conditions that allowed the disease to spread further into other regions. Cattle movements were highly responsible for the spread of lung sicknesses. During the later outbreak of lung sickness in Namaqualand in 1859, people were scattered as a result of the disease. An extract from a missionary notice describes this occurrence:

"*You will have heard, that, owing to lung-sickness, a disease among the cattle, the people had been scattered for more than two years*" (Missionary Notices, 1859, 225).

However, compared to the other regions, stringent measures were also put in place in the Namaqualand region to control the spread of lung sicknesses across the region. For example, civil commissioners in the Lelifontein station provided strict instructions to the native communities that all carcasses of the dead infected cattle should be buried appropriately. If native communities in Namaqualand did not abide by such stringent instructions it would result in the issuing of fines on the commission (Cape Town Archives 1/SBK 5/1/1 Letter Despatched by Civil Commissioner of Namaqualand: Civil Commissioner Leliefontein 22 December 1855).

Throughout the 1860s, lung sicknesses continued to ravage regions of southern Africa. Some documented years such as 1861 and 1864 were classified normal rainfall years for the Karoo (Lupini, 2015), while the year 1863 was a classified wet year in the Karoo (Lupini, 2015) and Namaqualand regions (Kelso, 2010). There was only one case of lung sickness reported in Lesotho throughout the 19thcentury, however this does not mean that the disease did not reach this region or cattle in this region remained unaffected. It could imply that it may not have been sufficiently widespread to report on or missionaries/travellers did not see it as a crisis for the region during the 19th century. Outbreaks of lung sickness in 1865 were associated with very dry/drought conditions in KwaZulu-Natal (Klein *et al*., 2016) and Namaqualand (Kelso, 2010). The year 1867 in KwaZulu-Natal was classified as having seasonal rains (Klein *et al*., 2016), while the outbreak of lung sickness during this period indicated that the impact of the disease had a negative effect on the supply of milk (ABC 15.4 vol. 6, Reel 177. Mission to Zulu land 1860 -1871 Report of the Umtuvaluve Mission station for the year ending May 29th 1867, Wilder). Milk was an important part of the diet of the indigenous people in KwaZulu-Natal and lung sickness therefore had a negative impact on food security for local indigenous people in this region. The outbreaks of lung sickness continuing into 1868, were also a result of cold and wet weather towards the end of winter (MHS, Mission Archives, A1045-131-9 Udland, 30 September 1868) as described below:

*"35 cattle died of lung disease which worsened by rain and cold at the end of August" (*MHS, Mission Archives, A1045-131-9 Udland, 30 September 1868).

Literature by Masiga *et al*. (1996), described that lung sickness outbreaks in southern Africa were rife due to cattle being imported from European countries such as the Netherlands during 1853/54. Compared to the climate in the Netherlands, southern African climates are hotter and harsher environments making is harder for cattle to withstand such arid climates.

The most widespread impacts of lung sickness were massive cattle losses in the Kalahari region during the year 1860 (LMS C 32-1-A W. Ashton Kuruman 3 October 1860). Impacts of lung sickness reported in the Kalahari region have also displayed a period of hardship and suffering amongst the indigenous people. The lung sickness had a severe impact on the provision of milk whilst substitution of food to cope with such losses, were a means of survival. This is further highlighted below:

"Our people are suffering a good deal for want of food, for since the 'lung sickness' carried off so many of their cattle they have not milk as they used to have to make their grain last out longer, and to have a substitute when other food failed" (LMS C 32-1-A W.Ashton Kuruman 3 October 1860).

Cattle deaths were widespread and inevitable during the 19th century when lung sickness appeared in southern Africa. The majority of the impacts recorded, indicated that cattle losses were prevalent and a common occurrence, which indicates that there was a lack of preventative measures to control the amount of cattle losses occurring. Such losses of cattle were recorded by missionaries and travellers during the 19th century and these were described as having devastating impacts on peoples' livelihoods. These cattle deaths were described for KwaZulu-Natal, the Karoo and Kalahari regions (Table 5-11).

Table 5-11: Descriptive mentions of cattle losses due to lung sickness for the 19th century southern Africa

Region	Quotation	Reference
KwaZulu-Natal (1855)	Many cattle belonging to the mission have been destroyed the past year by the "Lung Sickness"	Harvard, Houghton Library, ABC 15.4, vol. 4, Southern Africa, Zulu Mission 1847-59
KwaZulu-Natal (1856)	"This country is still afflicted by what is called the lung sickness by which cattle in large numbers are dying. Our mission and the people at our stations have lost many oxen. Some of the people who had just got a few of oxen, plough and wagon, have lost nearly on quite all their oxen, which disheartens them very much".	Harvard, Houghton Library, ABC 15.4, vol. 4, Southern Africa, Zulu Mission 1847-59
Kalahari (1860)	"Our people are suffering a good deal for want of food, for since the 'lung sickness' carried off so many of their cattle they have not milk as they used to have to make their grain last out longer, and to have a substitute when other food failed".	LMS C 32-1-A W.Ashton Kuruman 3 October 1860
KwaZulu-Natal (1896)	"Lung sickness and horse sickness which carried away nearly all the remaining livestock".	Harvard, Houghton Library, ABC 15.4, vol. 13, Southern Africa, Zulu Mission 1890-99

Karoo	"The disease has carried off may cattle in thousands".	Graaff Reinet Herald Wednesday 9 May 1855

The Graaff Reinet Herald (Wednesday 9 May 1855) reported that the humid state of the atmosphere could be a factor that attributed to the outbreak of lung sickness for the lower Albany region in the Karoo. Cattle losses were even quantified for the Karoo with "*247 out of 275 cattle lost in 6 weeks*" (Graaff Reinet Herald, Wednesday 9 May 1855). Other description of losses in different kraals reported "*80 out of 90 cattle lost*" (Graaff Reinet Herald, Wednesday 9 May 1855). While other impacts that have been recorded in the Karoo region indicated that lung sickness affected the breeding of cattle which has swept off cattle in numerous quantities:

"*The plague of lung sickness has prevented the breeding of cattle being followed, the disease has carried off many thousands*". (Cape and Natal News 1 November 1859)

In the Kalahari, indigenous people were practicing substitution of food sources during the outbreak of lung sicknesses in 1860 (LMS C 32-1-AW. Ashton Kuruman 3 October 1860). Due to the dependency of cattle in the region, not just for economic gains (Silberbauer and Logan, 2017), but also for subsistence such as milk, the inhabitants of the region had suffered a great deal due to shortage of milk. Milk was a staple form of diet, and this led to food substitution to cope with the severe shortages of milk due to lung sickness (LMS C 32-1-A W. Ashton Kuruman 3 October 1860). Similar practices were being undertaken in KwaZulu-Natal, later during 1867 when milk was also regarded as a staple part of the Zulu diet. It was recorded that milk was a chief "*dependence of the people during failure of cereal crops*" (ABC 15.4 Vol. 6, Reel 177.Mission to Zulu land 1860-1871 Report of the Umtuvaluve Mission station for the year ending May 29th 1867). Food substitution in this regard was followed by a diet which then relied wholly on wild plants and other means of receiving food was through food imports from remote areas such as Pietermaritzburg at higher prices such that only a few could afford (Report of the Umtuvaluve Mission station for the year ending May 29th 1867).

Cattle were also a primary means of transport during the 19th century and lung sickness had negative consequences on the prices and availability of transport. In both KwaZulu-Natal and Namaqualand, during the year 1860, references to impacts on transport were made by travellers and missionaries in the various source documents (Natal Witness 17 August 1860, Burman in Ross, 1996, C.121). However, in Namaqualand, indigenous people already started to replace cattle with mules for transportation (Burman in Ross, 1996, C.121). While in KwaZulu-Natal, reference was made to the fact that consideration should be given to building of a railway between the city and port to ease traffic (Natal Witness 17 August1860). This

indicates the different means of interventions by the different regions in relation to their locations.

5.5.2 Rinderpest

The total count of rinderpest outbreaks recorded for the 19th century is 120. The majority of cases were documented in KwaZulu-Natal (a total count of 97 [81%]), while rinderpest was documented twice in Namaqualand (Figure 5-14). There were no documented records of the disease affecting cattle in the Karoo region during this period, however it does not imply that the disease was not affecting the Karoo region, as horses were widely used as a means of transport there.

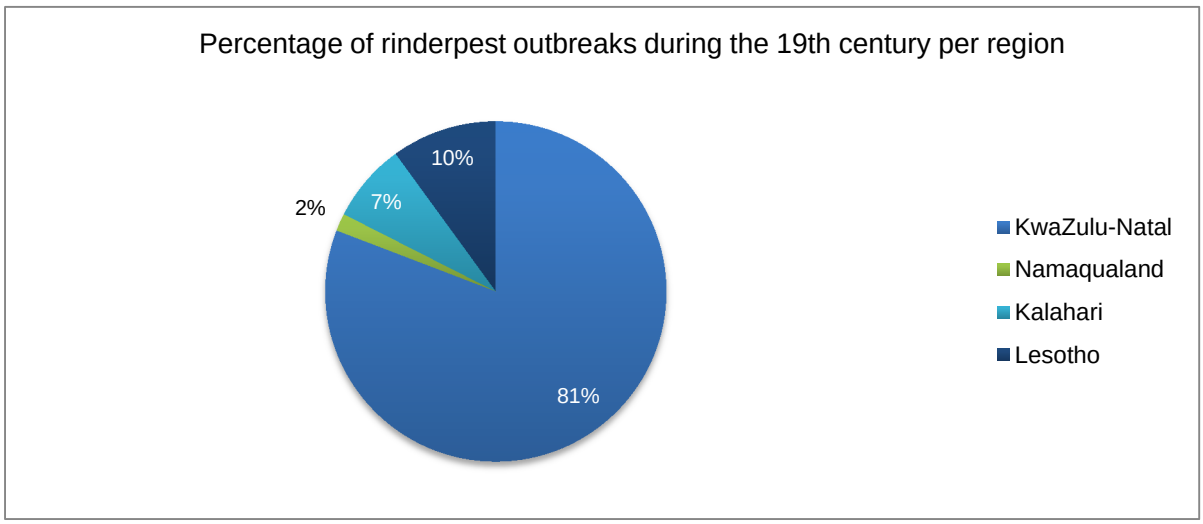


Figure 5-14: Percentage of reported rinderpest outbreaks across southern Africa during the 19th century

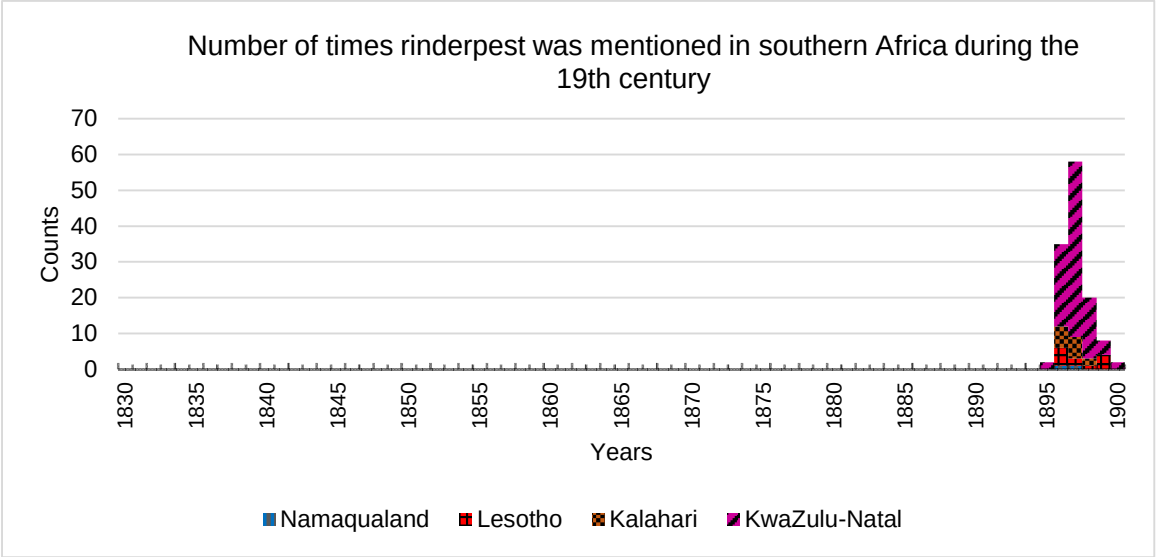


Figure 5-15: Counts of rinderpest outbreaks across southern Africa during the 19th century

Rinderpest started in KwaZulu-Natal in 1895 (a year classified as very dry year) and was mentioned twice for the KwaZulu-Natal region, a period during which the disease slowly made its way into southern Africa. Documented cases of rinderpest in southern Africa, supports the literature by van Onselen (1972), which confirms that the arrival of rinderpest appeared in the 1890s in southern Africa. By 1896, the disease had spread into Lesotho (five counts); Namaqualand (one count); Kalahari (six counts); and again appeared in KwaZulu-Natal (23 counts). Rinderpest associated with southern Africa indicated that in four of the years in which the disease was documented, were classified as very dry/drought years and four were relatively dry years as recorded by Kelso (2010) for Namaqualand, Nash and Grab (2010) for Lesotho, Klein *et al*. (2016) for KwaZulu-Natal, and Nash and Endfield (2002) for the Kalahari. Such droughts were linked to the 1896-97 El Niño events (Klein *et al*., 2016). No rinderpest was mentioned during relatively wet years. This could mean that diseases worsened during El Niño years. The work by Sunseri (2016) confirms that El Niño events caused severe droughts, which resulted in infected livestock and cattle to migrate to other areas in search of water sources, waterholes, lakes and wells. The graph (Figure 5-16) indicates that although there were records of very dry/drought years, majority of the rinderpest counts (49) were documented in relatively dry years in KwaZulu-Natal.

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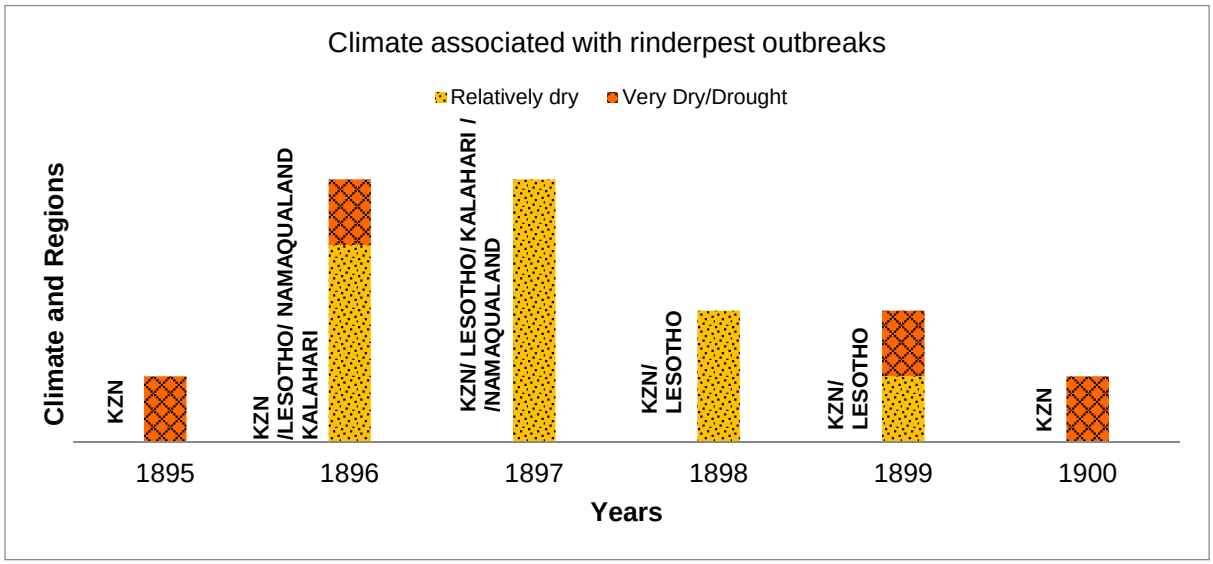

Figure 5-16: Climate associated with rinderpest outbreaks

There were various mentions of societal/economic consequences resulting from rinderpest outbreaks during the 19th century. Each region experienced variable impacts during the years in which the disease occurred. Apart from cattle losses, the cumulative impacts of rinderpest recorded during the 19th century were noted to include economic losses, increases in commodities/transport, prohibition of ox drawn transport, pollution to rivers, and impact on customary religious practices (Table 5-12). Economic losses associated with rinderpest

coupled with droughts and locust impacts were recorded in KwaZulu-Natal during 1896 and 1897. Such economic impacts resulted in the Government of KwaZulu-Natal implementing cutback of grants from $ 1150 to $ 530 (Missionsblatt 44/7, Hermannsburg 1897, 148-50). The government during this period had to continue cattle farming operations and as a result of the rinderpest outbreaks they remained compelled to purchase more cattle in order to "*keep the laundry going*" (Bunker, F.R. Harvard, Houghton Library, ABC 15.4, vol. 13, southern Africa, Zulu Mission 1890-99). In addition to the rinderpest reported for KwaZulu-Natal during 1895-97, the situation was further aggravated by the plague of locusts and crop failures (Klein *et a*l., 2016). Documented evidence further supports the findings of Ballard (1983) who reported that the locust plague weakened peasants in material ways and made them more susceptible and vulnerable to the blight of rinderpest. In KwaZulu-Natal, this has been reported by Hance, Esidumbini, October 1897:

"*For over two years we have had a great plague of locusts. Some kinds of crops they have continually destroyed, now the whole of South Africa swamped with rinderpest*" (ABC WBM 15.6.2. vol. 1 (A 467, 220, 98).

Table 5-12: Documented rinderpest impacts across southern Africa

Regions	Impacts	Rinderpest Outbreak Years						References
		1895	1896	1897	1898	1899	1900	
KwaZulu-Natal	Loss in value of oxen		×					Missionsblatt 44/5, Hermannsburg 1897, 97-8 Missionsblatt 43/12, Hermannsburg 1896, 231-4
	Cutbacks in government grants/economic			×				Missionsblatt 44/7, Hermannsburg 1897, 148-50
	Cattle deaths		×			×		Missionsblatt 43/12, Hermannsburg 1896, 231-4 Harvard, Houghton Library, ABC 15.4, vol. 13, Southern Africa, Zulu Mission 1890-99 Mellen, Esidumbini report for 1897-98 Harvard, Houghton Library, ABC 15.4, vol. 13, Southern Africa, Zulu Mission 1890-99 Missionsblatt 46/2, Hermannsburg 1899, 31 Harvard, Houghton Library, ABC 15.6.2, vol. 1. Zulu, East Africa, Woman's Board of Missions 1886-1899 USPG E52b, S.M. Samuelson, St Paul's, Zululand, 31 December 1897 Missionsblatt 46/11, Hermannsburg 1899, 259-61
	Impacts to transport			×	×	×	×	Missionsblatt 45/1, Hermannsburg 1898, 4-5 Harvard, Houghton Library, ABC 15.4, vol. 13, Southern Africa, Zulu Mission 1890-99 USPG D126b, Bishop of Zululand, Hlabisa, 26 February 1898 Missionsblad 23. årg. no 6 juni 1899 Hans Astup, (udatert) Missionsblatt 48/2, Hermannsburg 1901, 17-18
	Impacts to customary Zulu practices			×				USPG D122b, Bishop of Zululand, Eshowe, 22 September 1897
	Increase in the price of provisions (milk, meat, butter)/reduced milk supplies			×				Missionsblatt 46/2, Hermannsburg 1899, 31
	Pollution of rivers due to cattle infected carcasses			×				Harvard, Houghton Library, ABC 15.4, vol. 13, southern Africa, Zulu Mission 1890-99
Kalahari	Air pollution from dead cattle				×			LMS R Box 3 J. Good Kanye , no date 1898
Lesotho	Delayed travels due to closed borders		×					SPG E51b (1896) Report of Rev. S. Weigall, Masite, for the quarter ending 31 December 1896

The report of M.A Reading (1899) highlighted that in Lesotho, indigenous people were faced with great difficulty which was also coupled with the impacts of a drought, famine and locust outbreaks. These findings are consistent with those of Phoofolo (2003), who established that when rinderpest spread into Lesotho, the region was also experiencing other climatic, ecological and pestilential disasters concurrently. As identified by Eldredge (1987), the locust outbreaks in Lesotho during 1892 and 1894 to 1899, resulted in major crops failures and food scarcity, this is consistent with the documented findings in Lesotho recorded for the quarter ending 31 December 1899 which described famine, amongst locusts, rinderpest and droughts:

"*The past year has been an uneventful one as regards any special increase of numbers, although 135 adults and 23 infants have been baptised. The people have been sorely tried by the continuing effects of the plague of rinderpest, and by drought, famine and locusts" (*SPG E54a (1899) Report of Rev. M.A. Reading, Mohales Hoek, for the quarter ending 31 December 1899).

Cumulative impacts of rinderpest recorded in Lesotho during 1897 indicated that poverty was rife once during 1897 and in relation to the rinderpest, horses were utilized as alternate means of transport and were unable to be nourished due to the quantity of food decreasing during such rinderpest outbreaks. This was due to the shortage of transport required to import food into the region from other areas.

The year 1897 was a relatively dry year in Lesotho (Nash and Grab, 2010), as such a long continued drought affected the conditions of pastures for horses (LNA Incoming Letters - Maseru District S7/1/4/8? R.M. Smith, Maseru, 29 September 1897). Drought coupled with rinderpest made it difficult for Lesotho to cope during this period, in addition, sources of mealie which were purchased by the government were further rationed and deemed insufficient to meet the feed requirements for horses (LNA Incoming Letters - Maseru District S7/1/4/8? R.M. Smith, Maseru, 29 September 1897).

During the 19th century, cattle were regarded as a form of wealth so a disease such as rinderpest would leave devastating impacts on community wealth, resulting in poverty (Youde, 2013). Missionary, R.M Smit (1897) reported that additional maize had to be purchased to sustain horses which were being utilized for transport to replace oxen. However, this was not sufficient to meet the dietary needs of horses, despite quantities of feed being rationed per person. This is further highlighted in the quotation by R.M Smit:

"I have the honour to report that in reply to the Resident Commissioner's inquiries into the poverty of the police horses; though 117 bags of mealies were purchased for this detachment

*in May last the supply was finished on the 2nd September. The ration per man was 5lbs per night, this allowance though sufficient in an ordinary year was owing to the extra amount of mounted duty occasioned by Rinderpest not enough to keep the horses in good condition" (*R.M Smith, Maseru 29 September 1897,LNA Incoming Letters - Maseru District S7/1/4/8).

Social unrests were reported to have occurred during the period 1897 in KwaZulu-Natal as rinderpest and droughts were noted to have made people very troubled (Mellen, Esidumbini,18.10. 1897 Harvard, Houghton Library, ABC 15.6.2, vol. 1. Zulu, East Africa, Woman's Board of Missions 1886-1899). Such conflicts appeared to be worsened through the rinderpest outbreaks, with local people using rinderpest to sabotage other tribes. Travellers who have diarized such social conflicts also described that the Zulus were not co-operative in terms of hindering the spread of rinderpest (ABC WBM 15.6.2. vol. 1 (A 467, 220, 177) Harvard, Houghton Library, ABC 15.6.2, vol. 1. Zulu, East Africa, Woman's Board of Missions 1886-1899). Cattle inoculations were also disputed, as described below, and this also stemmed from political conflicts between the black and white natives. This supports the finding of Ballard (1983) who argued that natives believed that rinderpest was caused by the white man, and refused to believe that inoculation was an effective method of preventing the disease from spreading.

"*The dread cattle disease – "rinderpest" - has reached the reserve. In three kraals the entire herds are been [sic] swept off; we are anxious about the effect upon the people; with their superstition, and mutual fear and hatred, they will use the disease to pay off old scores, and thus help rather than hinder its progress. We have already heard of one man who buried a portion of a diseased carcass in his enemy's kraal in order to infect cattle. They have no conscience and even will seek or cause misery in others for the sake of company! These are the downright heathen; the more enlightened have learned better: one of the latter came yesterday, an intelligent man in whom we are much interested, was chief wife and mother have recently become Christians. Speaking of rinderpest and there and their unwillingness to take precautions against it by inoculating their cattle said, "We are a people who think only of the present, it is just like the warnings you give us about the world to come: we are so satisfied with this live we do not want troubled about laying plans for a future life, therefore we do not listen*" (ABC WBM 15.6.2. vol. 1 (A 467, 220, 177) Harvard, Houghton Library, ABC 15.6.2, vol. 1. Zulu, East Africa, Woman's Board of Missions 1886-1899).

The rinderpest outbreaks coupled with the droughts made life quite difficult for indigenous people and approaching wars had contributed towards such uneasiness (USPG E51b, S.M. Samuelson, Polela, 31 December 1896). The impact of rinderpest on customary practices was

also mentioned once for KwaZulu-Natal during 1897 by the Bishop of Zululand in 1897(USPG D122b, Bishop of Zululand, Eshowe, 22 September 1897). Customary practices such as religious rituals, ceremonies, and wedding traditions were reliant on cattle and due to rinderpest outbreaks such customs were withdrawn.

"I told you last week that I would try to write you an account of a four months trip from which I have just returned. Since I have been away rinderpest has broken out in this part of the country and it is now spreading fast all over the Diocese. In addition to this large swarms of locusts have appeared so that our outlook from some points of view is not very cheery. It is difficult to guess what may be the result of this rinderpest for our people – so many of their customs, especially marriage, have to do with cattle" (USPG D122b, Bishop of Zululand, Eshowe, 22 September 1897*).*

Water pollution from infected carcasses was also a consequence of the disease and was noted to occur twice during the periods 1897 and 1898 for the KwaZulu-Natal and Kalahari regions respectively. Records state that the carcasses of infected cattle were left in the Umzumbe River in KwaZulu-Natal, which left the river polluted (Harvard, Houghton Library, ABC 15.4, vol. 13, Southern Africa, Zulu Mission 1890-99, LMS R Box 3 J.Good Kanye, no date 1898).

However, the government in KwaZulu-Natal at the time indicated that nothing could be done as an intervention measure since there were no laws preventing the pollution of streams during this period. Stringent environmental regulations and laws which are in existence today in southern Africa were not imposed during the 19th century and no control was taken to address pollution during this period. Other means of coping highlighted recommendations to obtain alternate sources of drinking water due to such contamination. Amongst other interventions in KwaZulu-Natal, was the closure of schools to prevent the spread of the disease during rinderpest (Malcolm, 1897, Harvard, Houghton Library, ABC 15.4, vol. 13, Southern Africa, Zulu Mission 1890-99).

Cattle were used as a primary means of transport during the 19th century and the effect of rinderpest had a relatively high impact on transportation in southern Africa. Transport was affected in two ways by rinderpest outbreaks, which included the prohibition of the use of cattle for transport riding and increase in the cost of transport which had a direct impact on the cost of commodities. Documentary evidence for Lesotho highlighted that rinderpest dominated Basutoland during the period 1897 and as a direct effect of this was raising transport costs as described by Rev. J. Widdicombe (1897):

"*I have nothing important to mention, except that the rinderpest is now all over Basutoland and has during the past fortnight appeared in our very midst… transport rates have been trebled, and the price of provisions is rising rapidly"* (SPG E52b 1897 Report of Rev. J. Widdicombe, Thlotse Heights, for the quarter ending 30 June 1897).

Transport rates were affected mainly because indigenous people had to invest money in using horses or other animals as a means of transportation, which consequently cost more. In addition, with cattle scarcity, the demand for transport and goods would further have economic impacts to prices, market trading and provision of goods. The impacts of rinderpest on transport had severe impacts on food sources, since draught oxen were used as a primary means of transporting food regionally, with KwaZulu-Natal being affected in 1899.

"Improvements to the horrific destruction of the rinderpest: in transvaal, even worse, many people have died of hunger, due to lack of means of transport. This year, the maize that has come into the earth looks promising so far, just as last year's harvest was also good in many places. It was 95's harvest that was so pure unsuccessful. We have had plenty of rain this year, and the grasshoppers have so far not been as frequent and greedy as before". (Missionsblad 23. årg. no 6 Juni 1899 Hans Astup, (udatert)).

Towards the end of the century, rinderpest outbreaks were less documented, with only one case of it in KwaZulu-Natal in 1900. This suggests that although the outbreaks were less frequent, the region made a slow recovery from the disease, while other regions were clear of rinderpest by 1900. Documented evidence for the Kalahari indicates that in 1898 the region had recovered from rinderpest:

"*Rinderpest and famine will disappear and in fact are already disappearing*" (LMS C 55-1-A J.T. Brown Vryburg 21 March 1898).

A key factor which may have contributed to the slowdown of outbreaks were the interventions that were adopted by the Natal and Lesotho government from 1896, which involved the introduction of rinderpest regulations to control the disease from spreading further. Documented cases in KwaZulu-Natal allude to these interventions in 1896-1897. The Natal Witness reported that rinderpest meetings took place for the general purpose of discussing the "*rinderpest rules and regulations*" (Natal Witness 29 September 1896). Such meetings were also seen as an intervention to help control the disease. Meetings amongst farmers were further conducted to discuss such rules and regulations, and are highlighted in the statement below:

"The farmers of Dundee district held a meeting on Saturday afternoon in the courthouse at Dundee for the purpose of discussing generally the rinderpest rules and regulations and appointing Commissioners for the district" (Natal Witness 26 September 1896).

Stringent regulations in Lesotho were already enforced in 1896 and prohibited any cross border movement in order to prevent the transmission of rinderpest into the region. Specific instructions were further made with regards to travel and mobility amongst indigenous people. Limited mobility was allowed should people be transporting the disease with them, furthermore all Europeans entering Basotholand were given strict instructions pertaining to hygiene which they had to abide by. Descriptive illustrations of such measures are further shown below:

" A new school master has been secured but owing to the Rinderpest – cattle plague – regulations, he may not be able to come at X-mas as arranged, for the drifts are all closed and in the Free State indigenous people are forbidden to move about, lest they should carry the disease with them. Europeans entering Basutoland have to take a bath, use carbolic soap and have their clothes baked in an oven. The Basutoland Govt have strained every nerve to prevent its coming into the country but last week several cattle died, some miles away, from a sickness which it is feared is rinderpest" (SPG E51b (1896) Report of Rev. J. Deacon, Tsikoane, for the quarter ending 30 September 1896).

The serum inoculation method was introduced into Natal in September 1897 from the former 'Transvaal' (Ballard, 1983). During mid-October 1897, rinderpest officials in Natal were busy with inoculations throughout much of the Natal colony (Ballard, 1983), this has been documented by Hance, Esidumbini as follows:*"Now the whole of South Africa swamped with rinderpest. It has reached our station; we heard yesterday of two cattle that died of it quite near. It is not two months after it came into Natal, and now it is raging fearfully in all directions. Many thousands of cattle have already died. White farmers [...] of four or five hundred cattle, some have saved a few, others have lost all. The government here got out noted English and German specialists to see what could be done. Many cattle have been inoculated in various ways; in some herds the disease has been [...], in others the inoculation has brought the disease. The northern people are very superstitious about the disease, and in many reserves will not allow inoculation. Within a few weeks there will be few cattle left here"* (ABC WBM 15.6.2. vol. 1 A 467, 220, p 98).

Black peasants believed that rinderpest was caused by the white man, and refused to believe that inoculation was an effective method of preventing the disease from spreading (Ballard, 1983). During the later months of 1897, the bile methods were used for inoculating infected cattle (Ballard, 1983). This has been documented in KwaZulu-Natal:

"The scourge of rinderpest has swept through the whole district with devastating effect especially to the indigenous people. Their gods are broken. Many are surprised that the quiet which has reigned and the stoical method in which met their losses. It may be set in regard to this, that the punch is not felt as yet. Many sold a few cattle or sold the skins and obtained enough ready money to make them oblivious to the future African life. The taxes we easily paid this year but next year at planting time the extent of their loss will begin to be felt. Furthermore that the time of the "Black Death" in Italy they have given themselves to dancing at feasting and doubtless in many cases (and should judge particularly so it Newtonville) eaten diseased meat and died. Many deaths of unusual sort the reported at Newtonville.

Not a few have taken the scourge as a punishment for sin but very few have been led to repentance. There may be a greater softness of heart and hence opportunity to hear the gospel. Many tried inoculation but too late. In the Ifafa district many white farmers the successful in the use of serum: at Umtwalume a good many cattle were saved by the use of the bile method" (ABC 15.4. vol. 13 (A 467, 188, p90).

Even though there were stringent measures being taken to control rinderpest, the disease still continued in 1900 in KwaZulu-Natal. Although there were not many documented mentions of rinderpest compared to 1896 and 1897, rinderpest was not fully eradicated from KwaZulu-Natal. Documentary evidence for KwaZulu-Natal also mentioned that late vaccinations in 1900 resulted in the rinderpest plague not being fully eradicated (Missionsblatt 48/2, Hermannsburg 1901, 17-18). Literature by Phoofolo (2003) also highlighted that Basotho's were not severely affected by rinderpest like other regions in southern Africa. From documentary observations undertaken in this study, it was observed that recovery in Lesotho was quicker than KwaZulu-Natal, particularly because KwaZulu-Natal was faced with severe setbacks during 1895-1900, facing severe famine, massive crop damages recorded during 1895-1898, and widespread locust outbreaks during 1895-1899. The annihilation of cattle was therefore exacerbated by the severity of these impacts which were widespread towards the end of the 19th century.

5.5.3 African horse sickness

African horse sickness was common in the Karoo, KwaZulu-Natal and once each in Namaqualand and Lesotho regions (Figure 5-17). The total counts of the disease being mentioned equated to 28, including 14 times for the Karoo region and 12 times for KwaZulu-Natal. Zientara *et al*. (2015) described AHS as endemic to areas of southern Africa, with the largest outbreaks occurring in 1854-1855 and recording more than 70 000 horse fatalities. Heavy rains followed by periods of warm spells favour the occurrence and spread of AHS (Quan, 2004).

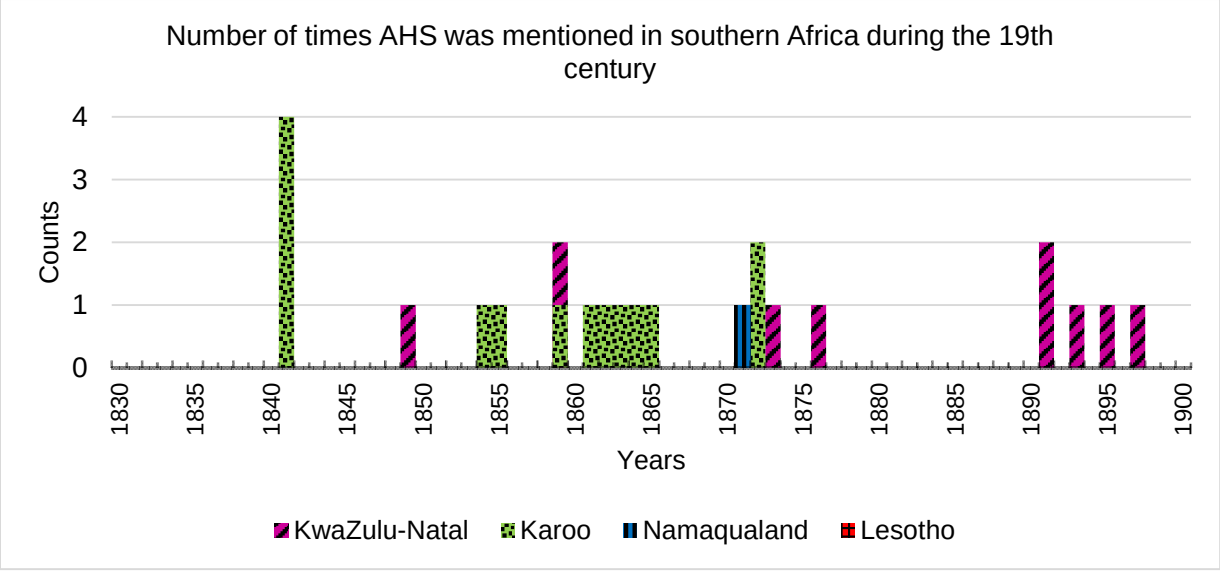

Figure 5-17: Counts of AHS outbreaks across southern Africa during the 19th century

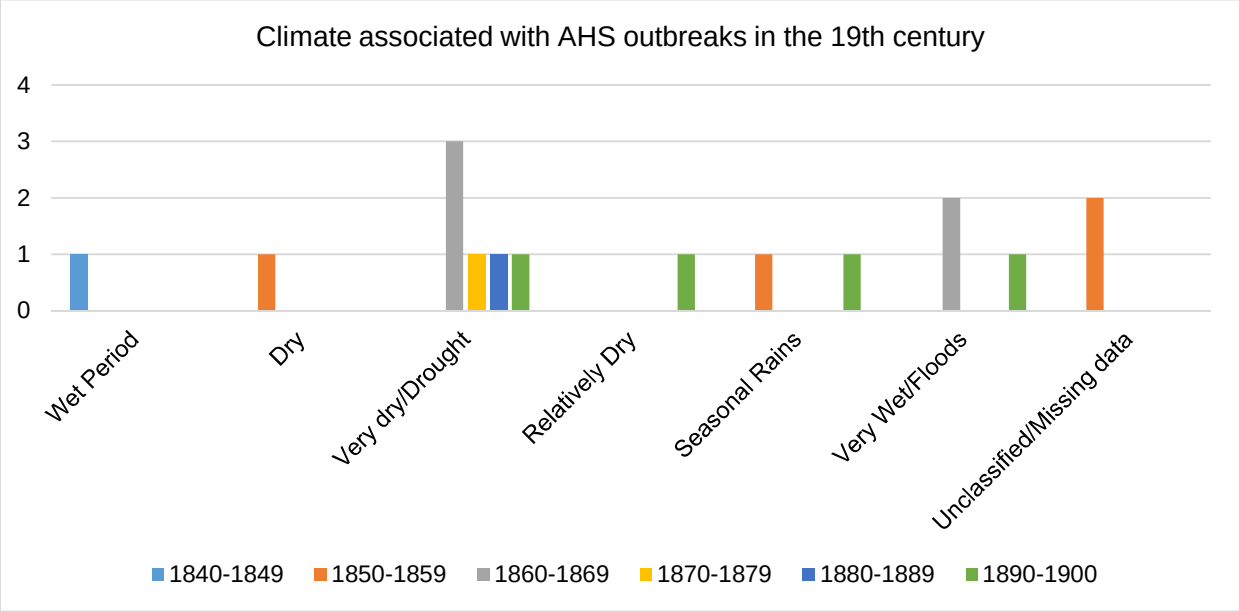

Figure 5-18: Climate associated with AHS outbreaks during the 19th century

The appearance of AHS in southern Africa, in relation to climate, shows that in majority of the years, AHS outbreaks took place during dry and very dry years. In addition, data (Figure 5-18) also indicate that the disease seemed to also flourish during wet periods (Figure 5-18). However, in comparison to wet years, the disease appeared more during periods in which the climate was classified as dry to very dry/drought, with seven of the 26 years being classified as very dry years. A pattern shows that wet periods/seasonal rains followed by relatively dry periods is most conducive to the disease occurring. This also coincides with the literature by Quan (2004) who indicated that heavy rains followed by periods of warm dry spells favour and flourish the occurrence of AHS epidemics. However, the outbreak of AHS could be attributed

to the fact that horses used in the South African war, imported from the northern hemisphere, made it difficult for such horses to withstand the changes in climate and weather (Vandenbergh, 2009). South African horses were not suitable or adapted for usage in the South African war as they were described as being much smaller breeds requiring smaller saddles (Vandenbergh, 2009). British military forces during the South African war, imported more than 400 000 horses which were from all parts of the world (Vandenbergh, 2009). This could also mean that diseases through imported horses were easily transferrable with no means of controlling or inspections of imported horses (Vandenbergh, 2009).

The periods 1860-1869 and 1890-1900 were recorded as years in which there were the most documented counts of AHS, recording six and seven counts respectively for those years. However, during the period 1860-1890, three of the years were recorded as very dry/drought conditions in which the disease broke out in the Karoo. The impacts of horse sicknesses in the Karoo resulted in fearful losses of horses, this is further depicted below:

"*The horse sickness is, I hope, nearly at the end. Fearful losses have been sustained. Many of my neighbours have not a horse left to ride. Few persons have saved in proportion*" (Graaff-Reinet Herald, Wednesday 9 May 1855).

"*We are sorry to learn that horse sickness has lately made its appearance in the neighbourhood of the Fish and koonap rivers and in the district of Somerset, where many horses have died of it… brought on by the same unhealthy state of the atmosphere that occasions dysentery among human beings*" (Cape Frontier Times, No 205 Vol 4, 18 April 1844)

During the 1890-1900 period, the peak in AHS was associated with varied climatic conditions in KwaZulu-Natal ranging from seasonal rains, very wet/floods, very dry/droughts and relatively dry periods. However, literature by Mellor and Hamblin (2004) indicate that the timing of El Niño events has a strong link between AHS outbreaks. Such links have shown that the warm phase of ENSO resulting in heavy rainfall followed by a drought in which no AHS occurs. However, the reverse condition during which droughts are followed by heavy rains results in AHS outbreaks.

Losses of horses from AHS were disruptive and had a direct impact for people using horse riding as a means of transport (Quan, 2004). Prior to automated transportation, horses similar to cattle played an important role in transportation of goods and people. For example, in the Karoo region during 1859, the Cape and Natal News 1861 (2 May-August) reported that the degree of horse sickness prevailed to such an extent that it affected the service of daily mails

and efficiency of postage. It was further reported that mails were discontinued and the timeframes for the delivery of mails were reduced to three times a week for areas such as Paarl, Tulbagh and Wellington (Cape and Natal News 1861 (2 May-August). This relates back to the work conducted by Vandenbergh (2009) who also reported that horse sicknesses during 1854-55 in the Cape region impaired the weekly mail transport. In addition, mail was often conveyed to and from Cape Town on a regular basis, however, during horse sickness outbreaks, this caused massive delays in mail dispatches (Vandenbergh, 2009).

5.6 Social impacts

Throughout the 19th century, there were various documented cases of social implications of droughts that were mentioned. Such social impacts were related to poverty and conflicts/unrests during periods of drought.

5.6.1 Poverty

Documented problems resulting in poverty as a social impact to adverse climatic conditions were mentioned 27 times across 22 of the 70 years in southern Africa (Figure 5-19). Most documented cases of poverty took place in Namaqualand and Lesotho, while KwaZulu-Natal only had two documented cases of poverty during the 19th century. Poverty is an indicator of vulnerability to climate extremes and climatic changes and is also directly related to lack of access to resources and social marginalization, which is serious when faced with disasters and livelihood stress (Adger, 1999). Data for southern Africa reveals that most instances of poverty were mentioned during drought/dry years with the exception of the years 1863 and 1885 for Lesotho, which was classified as very wet years, and 1873 was a relatively wet year. Drought induced poverty in southern Africa reveals that many indigenous people were not resilient or adaptive and therefore made them more vulnerable to such disasters. Documentary quotations by various missionaries and travellers in southern Africa indicate drought-induced poverty in the region:

Table 5-13: Descriptive mentions of drought-induced poverty in the 19th century southern Africa

Region	Quotation	Reference
Kalahari (1860)	p.64 Quoting a letter from Moffat: "…the poverty arising from drought has been felt in the comparatively small number of bibles purchased."	London Missionary Society (1861) Report of the Directors to the Sixty-Seventh General Meeting of the Missionary Society, usually called the London Missionary Society, on Thursday, May 9th 1861. Stevens: London.
Lesotho (1849)	p.448 "The collection which I have recently made in favour of the Missionary Society totalled £40.1.6. This figure is less than last year's, but if	Germond, R.C. (1967) Chronicles of Basutoland: a running commentary on the events of the

	one considers the poverty to which most of our people are reduced, it is a great deal. Half the contributors do not eat more than one meal in twenty-four hours. On account of the drought, it is two years since their last crop of millet, and this year again there is not the least prospect of them sowing their fields. There has been no rain for the last seven months and, even supposing it were to rain soon, the season is already too advanced for millet to succeed." (citing Pellissier, Bethulie, October 1849).	years 1830-1902 by the French protestant missionaries in Southern Africa. Morija Sesuto Book Depot, Morija, Lesotho.
Lesotho (1863)	The drought has been so intense and so prolonged that no old man remembers having seen anything similar in southern Africa. The death of cattle has been so great that thousands of families have been reduced to poverty.	PEMS AA FBN4 Mf.202. Pellisier, J. P. Béthulie. 16 Mars 1863.
Lesotho (1866)	"Our people have had, during the past two or three years, to struggle hard with poverty, caused by two very severe droughts and by repeated visitations of locusts; and again recently by the influx of refugee Basuto, fleeing from war and famine and having to be supported by them."	WMMS SA CORRESPONDENCE FBN5 Mf 179. A. Brigg, Wittebergen, 20 July 1866
Lesotho (1885)	P 3: People in Quthing are not getting any harvest and therefore poverty and hunger are looming.	Leselinyana La Lesotho 15 Loetse/September 1885
Lesotho (1899)	"In Basutoland, I think the church has continued to make good progress during the past year, though the people, especially in the south, have been in a state of deep poverty owing to the drought of last summer following on the rinderpest and now I hear that the summer rains have come too late to save the mealie crops, and in some places hailstorms and locusts have been very destructive, so that there is prospect of great destruction in many parts	SPG D130A (1899) Letter from Bishop of Bloemfontein, Bloemfontein, 21 January 1899
Namaqualand (1862)	But great as is the distress amongst the Hottentot Community, I am told that the want and poverty of the Damara population of this district is, if possible greater still. Within the last two or three years numbers of these people have come across the boundary into this Colony. They are often employed as shepherds by the farmers, but now like most of the Native labouring population have no employment nor have they any subsistence to fall back upon.	Letters of the Civil Commissioner, 1862, 204
Namaqualand (1875)	It is almost impossible to describe the poverty, the miserable way in which the poorer classes exist in this country in a severe drought; in good seasons they live principally upon corn, milk and roots; that part of the population in the neighborhoods of the mine, will as long as there is copper in the country, be well cared for in drought, as the Tram live between the Port and the Mine has been opened, and they can always be provided with the necessities of life from Cape Town	Civil Commissioner's Report, 1875
Namaqualand (1887)	I believe the three years drought from which this Division suffered in 1880. 1881. 1882 and the	Cape ArchivesLetter Book: Letters Dispatched by the Civil

	poverty – by that drought from which many of the inhabitants of Namaqualand have never recovered is the primary cause of this arrears	Commissioner of Namaqualand 1/SBK 5/1/6

Of the mentioned years during which poverty took place, the most devastating impacts were during the years 1896/1897 in the Kalahari in which there was widespread poverty coupled with hunger, sickness and even death (LMS R Box 2 J. Brown Taung 28 December 1897). There was also widespread starvation recorded during 1896 in the region (LMS C 53-2-A H. William Molepolole 15 May 1896). Cattle deaths in Lesotho were a major factor driving poverty in 1863, while a lack of sowing and harvests further devastating incomes and impacted on the quantity of food available (PEMS AA FBN4 Mf.202. Pellisier, J. P. Béthulie. 16 Mars 1863). Cattle and livestock ownership in southern Africa were a symbol of wealth and an income generating resource. As a result of droughts, cattle were reduced in numbers due to lack of food resources.

"*The drought has been so intense and so prolonged that no old man remembers having seen anything similar in southern Africa. The death of cattle has been so great that thousands of families have been reduced to poverty. No sowing, no harvests, no transport, a bag of wheat weighing 180# is sold at 200 francs and* still there was not enough to satisfy the needs of those who had the means of buying it at this price" (PEMS AA FBN4 Mf.202. Pellisier, J. P. Béthulie. 16 Mars 1863).

Documentary evidence for Namaqualand in 1869 has also indicated that severe poverty in areas such as Bushmanland and Springbokfontein have experienced serious poverty and as a result much cattle stealing was occurring (CCR, 1869). Letters of the Civil Commissioner have further highlighted that unemployment in Namaqualand reported during 1862 has also been a factor contributing to poverty (Letters of the Civil Commissioner, 1862, 204). Severe drought conditions were primarily responsible for poverty conditions and food shortages which resulted in indigenous people consuming wild food (Civil Commissioners Report, 1875). Other forms of poverty adaptation in Namaqualand were relief works implemented by the government in 1883. Government relief supplies were wheat, seed corn, rusks and other grains which supplied farmers (J.T. Eustace, Civil Commissioner and Resident Magistrate, Namaqualand 4 April 1883). Government relief measures were later mentioned in 1898 in the Kalahari region (LMS C 55-2-B E. Lloyd Kanye 22 September 1898). Relief measures were also a miscellaneous government response to hunger in the region.

"I have again begun relief work on account of the dreadful poverty and hunger of our people" "On account of the terrible hunger in the country the outlook for our work is not as cheerful as we could wish" (LMS C 55-2-B E. Lloyd Kanye 22 September 1898).

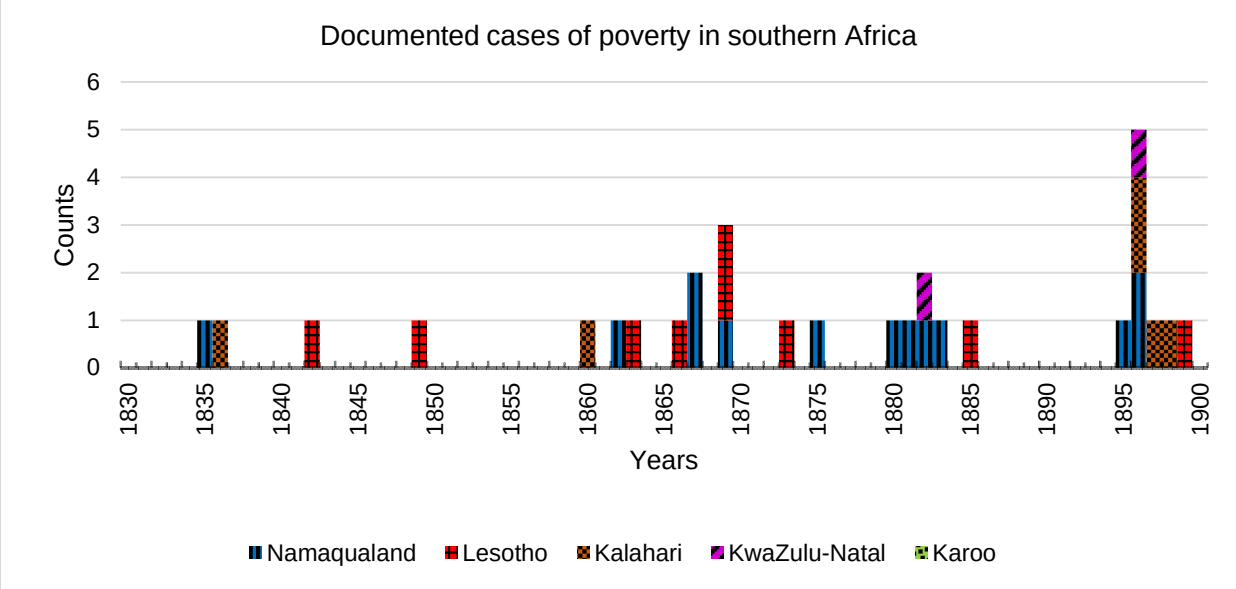

Figure 5-19: Counts of poverty across southern Africa during the 19th century

5.6.2 Impact duration and recovery times

This section highlights the duration of certain impacts for southern Africa including the time taken to recover from certain impacts pertaining to human health, droughts, famine, locust outbreaks and livestock diseases. Impact duration and recovery times for human health are shown in Table 5-14. Across southern Africa, Table 5-14 indicates that recovery times for human diseases were quick, with impacts of diseases typically lasting at most a year to 2 years, with the exception of the 1893-1897 dysentery outbreaks in the KwaZulu-Natal region which lasted for 5 consecutive years, whereas during the same period other regions remained clear of dysentery impacts. However KwaZulu-Natal recovered quickly thereafter with no significant impacts occuring towards the end of the century. Human health impacts recorded for Lesotho showed that the outbreaks of diseases for the region lasted only 1 year, which indicates that the region was able to recover quicker than other regions whilst it also had the least amount of documented health impacts.

Table 5-14: Recovery times and Impact duration for human health in southern Africa

		Impact Year					Recovery year			
	Karoo	**Impact and recovery Duration**	KwaZulu-Natal	**Impact and recovery Duration**	Kalahari	**Impact and recovery Duration**	Namaqualand	**Impact and recovery Duration**	Lesotho	**Impact and recovery Duration**
Dysentery	1840-1841	2 years	1863	1 year	1862	1 year			1883	1 year
	1842-1844	3 year recovery	1864	1 year recovery period	1863-1865	3 year recovery				
	1845	1 year	1865	1 year	1866	1 year				
	1846-1868	23 year recovery period	1866-1879	13 year recovery period	1867-1882	15 year recovery period				
	1869	1 year	1880	1 year	1883	1 year				
	1870-1900	Insufficient data	1884-1892	8 year recovery period	1883-1900	17 years recovery period				
			1893-1897	5 years						
			1898-1900	3 year recovery period						
Smallpox	1857	1 year	1862	1 year	1862	1 year			1854	1year
	1858-	1 year recovery period	1863-1893	30 year recovery period	1863-1893	30 year recovery period				
	1859-1860	2 years	1894	1 year	1894-1895	2 years				
	1861-1868	7 year recovery period								
	1869	1 year								
	1870-1900	30 year recovery period								
	Karoo	**Impact and recovery Duration**	KwaZulu-Natal	**Impact and recovery Duration**	Kalahari	**Impact and recovery Duration**	Namaqualand	**Impact and recovery Duration**	Lesotho	**Impact and recovery Duration**
Measles	1851	1 year	1892	1 year			1839	1 year	1839	1 year
	1852-1860	8 year recovery period	1893-1894	2 year recovery period			1840-1900	60 years recovery period	1840-1900	60 years recovery period
	1861-1862	2 years	1895	1 year						
	1863-1900	37 year recovery period	1896-1900	5 year recovery period						
typhoid			1890	1 year			1869	1 year	1859	1 year
			1891-1897	6 year recovery period			1870-1871	2 year recovery period		
			1898	1 year			1872	1 year		
			1899-1900	2 year recovery period			1873-1874	2 year recovery period		
							1875-1876	2 years		

							1877-1900	23 year recovery period		

The mention of locusts was widespread from the 1840s, Table 5-15 indicates the different impact duration and recovery periods for locust outbreaks across southern Africa. Early outbreaks of locusts revealed that impacts lasted up until only a year across the Karoo, KwaZulu-Natal, Namaqualand, and Lesotho for the periods 1832, 1837, 1836 and 1843 respectively. The 1847-1856 outbreaks in the Karoo lasted ten years, while the region was able to recuperate during the following years 1857-1863, this seven year recovery period lasted until 1864 during which there was another locust outbreak in the Karoo region. KwaZulu-Natal appeared to have longer periods of recovery, for example, the outbreaks following the year 1837 showed that 12 years passed between outbreaks, in 1850-1851 which only lasted two years until the outbreak in 1869 prior to a 17 year recovery period for the region. However towards the latter part of the century, KwaZulu-Natal appeared to be the only region which did not fully recover from locust outbreaks, despite interventions documented in 1894 such as burning of fires to eradicate locusts (Natal Witness 1 September 1894), such interventions were unsuccessful. Immediately following the recovery period in 1876-1891, outbreaks in 1892 also resulted in indigenous people lighting fires to grass pastures and beating of paraffin tins to annihilate the locust outbreaks (Natal Witness 6 September 1894).The majority of the documented impacts in the Kalahari showed that locust impacts lasted only for a year, with the exception of the outbreak between 1896 and 1898 which persisted for three years. By the end of the century, regions such as Namaqualand, Lesotho and the Kalahari were documented to remain clear of locust outbreaks, with the exception of the Karoo due to insufficient evidence. Documented evidence for KwaZulu-Natal revealed that locust outbreaks persisted from 1892 until 1900 which indicated that the region had a slower recovery period.

Table 5-15: Recovery times and Impact duration for locust outbreaks in southern Africa

Karoo	**Impact and recovery Duration**	KwaZulu-Natal	**Impact and recovery Duration**	Kalahari	**Impact and recovery Duration**	Namaqualand	**Impact and recovery Duration**	Lesotho	**Impact and recovery Duration**
1832	1 year	1837	1 year	1836	1 year	1836	1 year	1843	1 year
1833-1835	3 year recovery period	1838-1849	12 year recovery period	1837-1842	6 year recovery period	1837-1840	4 year recovery period	1844-1849	6 year recovery period
1836	1 year	1850-1851	2 years	1843	1 year	1841-1843	3 years	1850	1 year

1837 - 1839	3 year recovery period	1852-1868	17 year recovery period	1844-1852	9 year recovery period	1844-1893	49 year recovery period	1851-1852	2 year recovery period
1840 - 1845	5 years	1869	1 year	1853	1 year	1894	1 year	1853-1854	2 years
1846	1 year recovery period	1870-1874	5 year recovery period	1854-1868	14 year recovery period	1895-1900	5 year recovery period	1855-1863	9 year recovery period
1847 - 1856	10 years	1875	1 year	1869	1 year			1864-1869	6 years
1857 - 1863	7 years recovery period	1876-1891	16 year recovery period	1870	1 year recovery period			1870-1890	20 year recovery period
1864	1 year	1892-1900	9 years	1871	1 year			1891-1899	9 years
1865 - 1866	2 year recovery period			1872-1873	2 year recovery period			1900	1 year recovery period
1867 - 1875	9 years			1874-1875	2 years				
1876 - 1900	Insufficient data			1876-1891	16 year recovery period				
				1892	1 year				
				1893-1895	3 year recover period				
				1896-1898	3 years				
				1899-1900	2 year recovery period				

Table 5-16 highlights the recovery times and impact duration for famines across southern Africa. The earliest outbreaks of famine during the 1830s started in the Kalahari, Lesotho and Namaqualand regions and the impact lasted only a year. Typically most recovery periods after the initial famine outbreaks were long, with the Karoo having the longest recovery period of 19 years until the next outbreak in 1862. Namaqualand also experienced a long recovery period following the 1836 outbreak, and this recovery period was quick, the same with the outbreak in 1834-1837 for Lesotho. The 1850 outbreaks in KwaZulu-Natal were followed by a recovery period of six years during which there were no mentions of famine, however later outbreaks of famine lasted longer in the region with the outbreak in 1859-1863 lasting five years, the 1865-1870 outbreak lasting six years. The recovery period between these outbreaks were shorter, indicating that the region was able to recover quicker from longer periods of famine. The famine which occurred between 1884 and 1897 lasted for 14 years, the longest recorded impact duration for famines across southern Africa. Until the end of the century the region still experienced famine, which means that recovery was slow. As

compared to Namaqualand this region appeared to recover quickly from famines, with longer recovery periods and shorter impact duration. The same trend is shown for Lesotho and the Kalahari regions.

Table 5-16: Recovery times and Impact duration for famines in southern Africa

Karoo	**Impact and recovery Duration**	KwaZulu-Natal	**Impact and recovery Duration**	Kalahari	**Impact and recovery Duration**	Namaqualand	**Impact and recovery Duration**	Lesotho	**Impact and recovery Duration**
1842	1 year	1846-1847	2 years	1831	1 year	1836	1 year	1833	1 year
1843-1861	19 year recovery period	1848-1849	2 years	1832-1833	2 year recovery period	1837-1844	8 year recovery period	1834-1837	4 year recovery period
1862	1 year	1850	1 year	1834-1835	2 years	1845-1846	2 years	1838-1839	2 years
1863-1900	Insufficient data	1851-1856	6 year recovery period	1836-1838	3 year recovery period	1847-1850	4 year recovery period	1840	1 year recovery period
		1857	1 year	1839	1 year	1851	1 year	1841-1843	3 years
		1858	1 year recovery period	1840-1845	5 year recovery period	1852-1900	48 year recovery period	1844-1845	2 year recovery period
		1859-1863	5 years	1846-1847	2 years			1846	1 year
		1864	1 year recovery period	1848	1 year recovery period			1847-1850	4 year recovery period
		1865-1870	6 years	1849	1 year			1851	1 year
		1871	1 year recovery period	1850	1 year recovery period			1852-1857	7 year recovery period
		1872-1873	2 years	1851	1 year			1858-1864	7 year
		1874-1875	2 year recovery period	1852-1857	6 years recovery period			1865	1 year recovery period
		1876-1882	7 years	1858-1860	3 years			1866-1867	2 years
		1883	1 year recovery period	1861	1 year recovery period			1868	1 year recovery period
		1884-1897	14 years	1862-1863	2 years			1869	1 year
		1898	1 year recovery period	1864-1874	11 year recovery period			1870	1 year recovery period
		1899-1900	2 years	1875	1 year			1871	1 year
				1876-1877	2 year recovery period			1872-1874	3 year recovery period

				1878-1879	2 years			1875	1 year
				1880-1890	11 year recovery period			1876	1 year recovery period
				1891-1892	2 years			1877-1881	5 years
				1893-1894	2 year recovery period			1882-1883	2 year recovery period
				1895-1898	4 years			1884	1 year
				1899-1900	2 year recovery period			1885	1 year recovery period
								1886-1887	2 years
								1888-1890	3 year recovery period
								1891-1892	2 years
								1893-1896	4 year recovery period
								1897	1 year
								1898	1 year recovery period
								1899	1 year
								1900	1 year recovery period

The impacts of poverty were difficult to trace, however during the 19th century there were few documented cases of poverty which stood out in years of droughts and famine. However from documented sources it showed that poverty, in general lasted a year, and in regions like Namaqualand and Lesotho, longer periods of recovery are shown in Table 5-17 and Table 5-18 respectively whereas compared to Kalahari, although the region experienced few cases of poverty, the 1896-1898 outbreak lasted for three years which took the region two years to recover form until the end of the century.

Table 5-17: Recovery times and Impact duration for poverty in Namaqualand

Namaqualand	Impact duration	Recovery time
Documented year of poverty		
1835	1year	
1836-1861		25 years
1862	1 year	
1863-1866		4 years

1867	1 year	
1868		1 year
1869	1 year	
1870-1874		5 years
1875	1 year	
1876-1879		4 years
1880-1883	4 years	
1884-1894		11 years
1895-1896	2 years	
1897-1900		4 years

Table 5-18: Recovery times and Impact duration for poverty in Lesotho

Lesotho	Impact duration	Recovery time
Documented year of poverty		
1842	1 year	
1843-1848		7 years
1849	1 year	
1850-1862		12 years
1863	1 year	
1864-1865		2 years
1866	1 year	
1867-1868		2 years
1869	1 year	
1870-1872		3 years
1873	1 year	
1874-1884		11 years
1885	1 year	
1886-1898		13 years
1899	1 year	
1900		1 year

Table 5-19: Recovery times and Impact duration for poverty in the Kalahari

Kalahari	Impact duration	Recovery time
Documented year of poverty		
1836	1 year	
1837-1859		23 years
1860	1 year	
1861-1895		35 years
1896-1898	3 years	
1899-1900		2 years

Table 5-20: Recovery times and Impact duration for poverty in the KwaZulu-Natal

KwaZulu-Natal	Impact duration	Recovery time
Documented year of poverty		
1882	1 year	
1883-1895		13 years
1896	1 year	
1897-1900		4 years

Livestock diseases appeared during the middle of the 19th century, with most cases of sickness imported from cattle movements through trade routes. Documentary evidence for southern Africa reveals that the appearance of lung sickness in southern Africa typically lasted for a year in most regions, however the impact of lung sickness took a toll on the region and recovery periods vary across the region, for example, following the 1857 outbreak in the Karoo, the region experienced three years during which there was no documented evidence for lung sickness until it appeared again. Following the outbreak in 1855 reported in Namaqualand, the region experienced two consecutive years of recovery; this also implies that interventions such as replacement of oxen with mules for transport helped the region to recover (Hall in Ross, 1996, C.132).

Evidence of recovery for lung sickness in KwaZulu-Natal during 1859 is described below in a quotation extracted from the Natal Witness. While the region recovered from lung sickness, horse sickness was prevalent (Natal Witness, 25 March 1859).

"Within the last few weeks the disease among horses has been very prevalent, both in the vicinity of the city and ending up and counties. In some tracts of country, supposed to be entirely free from the danger, the disease is said to have broken out with fatal effect.

*Fortunately not much is heard of the lung disease among oxen, and these useful animals supply the place of draught horses that have been carried off by the distemper" (*Natal Witness, 25 March 1859).

Table 5-21: Recovery times and Impact duration for livestock diseases in southern Africa

	Karoo	**Impact and recovery Duration**	KwaZulu-Natal	**Impact and recovery Duration**	Kalahari	**Impact and recovery Duration**	Namaqualand	**Impact and recovery Duration**	Lesotho	**Impact and recovery Duration**
Lung sickness	1855	1 year	1853	1 year	1855-1856	2 years	1855-1856	2 years	1869	1 year
	1856	1 year recovery period	1854	1 year recovery period	1857-1859	3 year recovery period	1857-1858	2 year recovery period		
	1857	1 year	1855-1856	2 years	1860	1 year	1859-1860	2 years		
	1858-1860	3 year recovery period	1857-1859	3 year recovery period	1861-1900	40 year recovery period	1861-1862	2 year recovery period		
	1861	1 year	1860	1 year			1863	1 year		
	1862	1 year recovery period	1861	1 year recovery period			1864	1 year recovery period		
			1862	1 year			1865	1 year		
			1863	1 year recovery period			1866-1900	35 year recovery period		
			1864-1865	2 years						
			1866	1 year recovery period						
			1867	1 year						
			1868-1869	2 year recovery period						
			1870-1874	5 year						
			1875	1 year recovery period						
			1876-1877	2 years						
			1878	1 year recovery period						
			1879	1 year						

			1880-1881	2 year recovery period						
			1882	1 year						
			1883-1885	3 year recovery period						
			1886	1 year						
			1887-1888	2 year recovery period						
			1889	1 year						
			1890-1900	11 year recovery period						
	Karoo	**Impact and recovery Duration**	KwaZulu-Natal	**Impact and recovery Duration**	Kalahari	**Impact and recovery Duration**	Namaqualand	**Impact and recovery Duration**	Lesotho	**Impact and recovery Duration**
Rinderpest			1895-1900	6 years	1896-1898	3 years	1896-1897	2 years	1896-1899	4 years
					1899-1900	2 year recovery period	1898-1900	3 year recovery period	1900	1 year recovery period
AHS	1841	1 year	1849	1 year			1871	1 year		
	1842-1853	12 year recovery period	1850-1858	9 year recovery period						
	1854-1855	2 years	1859	1 year						
	1856-1858	3 year recovery period	1860-1872	13 year recovery period						
	1859	1 year	1873	1 year						
	1860	1 year recovery period	1874-1875	2 year recovery period						
	1861-1865	5 years	1876	1 year						
	1866-1871	6 year recovery period	1877-1890	14 year recovery period						
	1872	1 year	1891	1 year						

	1873 - 1900	28 year recovery period	1892	1 year recovery period						
			1893	1 year						
			1894	1 year recovery period						
			1895	1 year						
			1896	1 year recovery period						
			1897	1 year						
			1898-1900	3 year recovery period						

5.7 Coping and adaptation during the 19th century

Various methods of adaptation and coping were observed and documented in southern Africa during the 19th century. Majority of these adaptation mechanisms were a response to droughts, famine, food shortages and water scarcity. Such responses included migration and population dispersal, rainmaking, prayer for rains, digging for water, and changes in agro-pastoral processes.

5.7.1 Migration and population dispersal

Migration and population dispersal took place quite extensively across southern Africa during the 19th century. Migration was mentioned 57 times in documentary records during the 19th century. The most documented cases of migration were in the Namaqualand and KwaZulu-Natal regions (Figure 5-16). Migration started as early as 1831 in Namaqualand, thereafter the occurrence was quite common across other regions. In Namaqualand, migration took place mainly during very dry/drought years, with the exception of years 1831 and 1859 which were classified as wet years (Kelso, 2010). Regions such as the Kalahari also experienced wet years during 1852, 1862 and 1889 (Nash and Endfield, 2002), yet migration still occurred during such years. Similarly, during wet periods in KwaZulu-Natal during 1872-73, indigenous people were migrating in search of employment due to droughts experienced in interior regions of KwaZulu-Natal (Natal Witness 23 February 1872).

Descriptive mentions of migration indicated that people often moved elsewhere to seek food or other means of labour to survive. For instance, in Lesotho a condensed report of the Bloemfontein district (1877) highlighted that the year was a difficult one, threatened by droughts. Amongst the consequences of such a drought for Lesotho was a failed mealie

harvest impacting on food security, and desiccation of wells impacting on water resources (WMMS SA Synod Minutes FBN4, Mf.186, Bloemfontein District Minutes and Reports, 18 Jan. 1878 Report of the Thaba Nchu Circuit for the year 1877). Such impacts therefore compelled the local indigenous people to migrate elsewhere in search of food and employment (WMMS SA Synod Minutes FBN4, Mf.186, Bloemfontein District Minutes and Reports, 18 Jan. 1878 Report of the Thaba Nchu Circuit for the year 1877).

Migration was therefore a common response to food shortages, famines and droughts during the 19th century. Migration was also a response to agricultural crises during times of poor sowing/harvesting when water scarcity occurred due to droughts. For example, indigenous people in the Kalahari region were seeking new areas with available water resources for sowing and crop cultivation (LMS C 24-1-A H. Helmore Lekatlong 2 January 1849).

Although migration was documented as early as 1831, it was a response to widespread devastating famine in the Kalahari, particularly in the years 1846-1847, 1860, 1879 (LMS C 22-1-A W. Ross Taung 12 September 1846, LMS C 23-1-BW. Ashton Kuruman 2 August 1847, LMS C 32-1-A W. Ross Lekatlong 19 October 1860, LMS C 40-1-A R. Moffat Molopolole 2 January 1879). The year 1849 in the Kalahari was also particularly devastating for farmers who had to move their entire farms elsewhere in order to cope with devastating droughts (LMS C 24-1-A H. Helmore Lekatlong 2 January 1849). Such a situation has been described in detail by missionary correspondence:

"Now, however, the time of dispersion has come and as the season is very dry more families than normal have gone to their farms… one man lately removed his farm to a distance in consequence of the drought " (LMS C 24-1-A H. Helmore Lekatlong 2 January 1849).

Major crop failures and famines recorded for KwaZulu-Natal during 1836, 1862, 1872, 1878, 1882 and 1896 resulted in widespread population dispersal (USPG E9a, R. Robertson, Kwamagwaza, 7 April 1862, Natal Witness 10 September 1872, kvaMHS, Mission Archives, A1045-132-13 Stavem, 30 Desember 1872, ELM, ASA 41, 95, Müden/Natal, 1872-1895, USPG E37, J.M. Samuelson, St Paul's, Zululand, 1 June 1882). The year 1872 also showed a peak in the data for KwaZulu-Natal with many counts of migration taking place during this year. Documented records also reveal that there were some cases of conflicts over rainmaking during these years, in that rain doctors were to blame for lack of rains during a summer period (MHS, Mission Archives, A1045-132-11 Schreuder 1. July 1872). Such factors of conflicts, drought and famine could be the reason why extensive migration was recorded during such a year.

The documented famines were disturbing, such that populations in KwaZulu-Natal went in search of food (USPG E9a, R. Robertson, Kwamagwaza, 7 April 1862). Famine was a factor driving migration in Lesotho during 1882, and at the same time this was also happening in KwaZulu-Natal. In 1872, the Kalahari was also faced with harvest failures and small quantities of corn stocks, which triggered movement of people to escape hunger (LMS R Box 1C. Williams Molepolole 20 December 1872). Reports of deaths occurring during this period in Lesotho were a factor which enhanced and forced population movements across new regions in search of food (WMMS SA CORRESPONDENCE FBN6 Mf 211. G. Waterhouse, Wittebergen, 6 July 1882).

The failure of crops in some districts recorded in 1862 in KwaZulu-Natal triggered a food security issue in the region. While not all districts in KwaZulu-Natal were faced by such a crisis, this did not mean that the impact would not become widespread and start to affect other regions. Documented evidence suggested that famines were threatening to become rife in the region due to crop failures (USPG E9a, R. Robertson, Kwamagwaza, 7 April 1862). A description of migration prompted by such famines and food shortages in KwaZulu-Natal in 1862 is documented below, highlighting that indigenous people dispersed themselves in search of food.

"I am afraid we are going to have another year of famine. In some Districts the crops are an utter failure and the people have dispersed themselves elsewhere in search of food. One party has passed this place and I saw another at Entseleni" (USPG E9a, R. Robertson, Kwamagwaza, 7 April 1862).

A similar report is provided by the Natal Witness in 1872, which discussed the famine induced migrations taking place in Zululand (Natal Witness 10 September 1872). Although the year 1872 was a relatively wet year, the year 1871 was relatively dry. During the year 1872, KwaZulu-Natal could have been recovering from the previous dry year experienced in 1871 during which the region faced major food shortages and widespread famine conditions (Natal Witness 10 September 1872). Even though it was a relatively wet year, KwaZulu-Natal was still described as "hot, close, damp and dry" by Thomas Groom (1872) (KCM 98|75|3|3. Groom, Thomas, File 3. Diaries 1870-1875). The scarcity of food triggered population dispersal in search of food, while it was contested that indigenous people should also seek employment as a means for survival, as described by the Natal Witness:

"Zululand. We (Mercury) hear that great scarcity of food - almost amounting to a famine - prevails in certain districts, and that large numbers of people are wondering about in search

of sustenance. Why not seek work, which will give them food enough, as well as pay?" (Natal Witness 10 September 1872).

During the year 1896, locust outbreaks were one of the factors which resulted in the migration of indigenous people in KwaZulu-Natal (USPG E51b, S.M. Samuelson, Polela, 30 June 1896). Severe droughts and locusts were experienced in such a year, and the impacts thereof were loss of garden produce. With the lack of food and locust outbreaks, migration was an immediate response to the hardships presented in the year 1896. This was further documented by missionary S.M Samuelson as follows:

"*These are very hard times for the Christians who are greatly in want of help. The drought continues and the locusts visit us repeatedly, and eat up any little vegetables they had trusted in, so it is almost impossible for them to find sustenance for themselves and family. Some of the Christian families have left the station, only temporarily I hope, and gone to live with their heathen relatives, who seem to be better off for food than they, and if this state of things continue, I am afraid more of them will have to go*" (USPG E51b, S.M. Samuelson, Polela, 30 June 1896).

Towards the final years of the 19th century, migration was still happening in KwaZulu-Natal due to many factors. Economic downturn due to drought, food shortages and diseases such as dysentery during this year crippled the Natal economy (Harvard, Houghton Library, ABC 15.4, vol. 13, Southern Africa, Zulu Mission 1890-99). Drought induced famine also resulted in migration of people from Kwazulu-Natal to Transvaal; (Johannesburg) to seek employment and earn money (Missionsblatt 43/12, Hermannsburg 1896, 231-4). Severe droughts and rinderpest also affected the ability of the region to cope during this year (Missionsblad 23. årg. no 6 Juni 1899 Hans Astup, (udatert), Harvard, Houghton Library, ABC 15.6.2, vol. 1. Zulu, East Africa, Woman's Board of Missions 1886-1899, Missionsblatt 44/5, Hermannsburg 1897, 97-8). Transport costs were exceedingly high due to rinderpest outbreaks, while this also affected the health of oxen, as many were dying (Missionsblatt 48/2, Hermannsburg 1901, 17-18).

Compared to other regions, transhumance practices were widely adopted during the consecutive drought years between 1834 and 1846 in Namaqualand (Report of the London Missionary Society, presented at the General Meeting of the Missionary Society, held May 12, 1835, 97). The occurrence of transhumance practices were only recorded four years later (1850) in Lesotho. Droughts also forced many to engage in transhumance activities in order to keep their livestock alive by searching for food elsewhere.

p.448 "*The country which we traversed during this journey, which lasted from the 1st to the 25th of October, was already known to me, but I had never seen it so dry before… A drought of such extreme severity had forced many of our friends to fold their mats, to leave Jackal's Fountain and to seek pastures elsewhere for their flocks*…" (Citing Fredoux, Motheto, November 1850) (Germond, R.C. (1967) Chronicles of Basutoland: a running commentary on the events of the years 1830-1902 by the French protestant missionaries in Southern Africa. Morija Sesuto Book Depot, Morija, Lesotho).

These findings coincide with that O'Farrell *et al*. (2009), indicating that transhumance practices were a means of adaptation to evade unfavourable climatic conditions such as droughts. Moving of livestock across landscapes also presents opportunity to allow cattle to seek favourable forage across a variety of climatic regimes (O'Farrell *et al*., 2009). An example of transhumance practices that have been documented in Namaqualand is further described below:

"*Scarce a year passes that numbers of them are not obliged to remove to other places to seek for subsistence..... resided at Reits Fountain, and the people among whom he labours, have for the last year, been very much dispersed, on account of the drought, which has compelled them to migrate in search of pasture for their cattle*" (Reports of the London Missionary Society, 1835, 96-97).

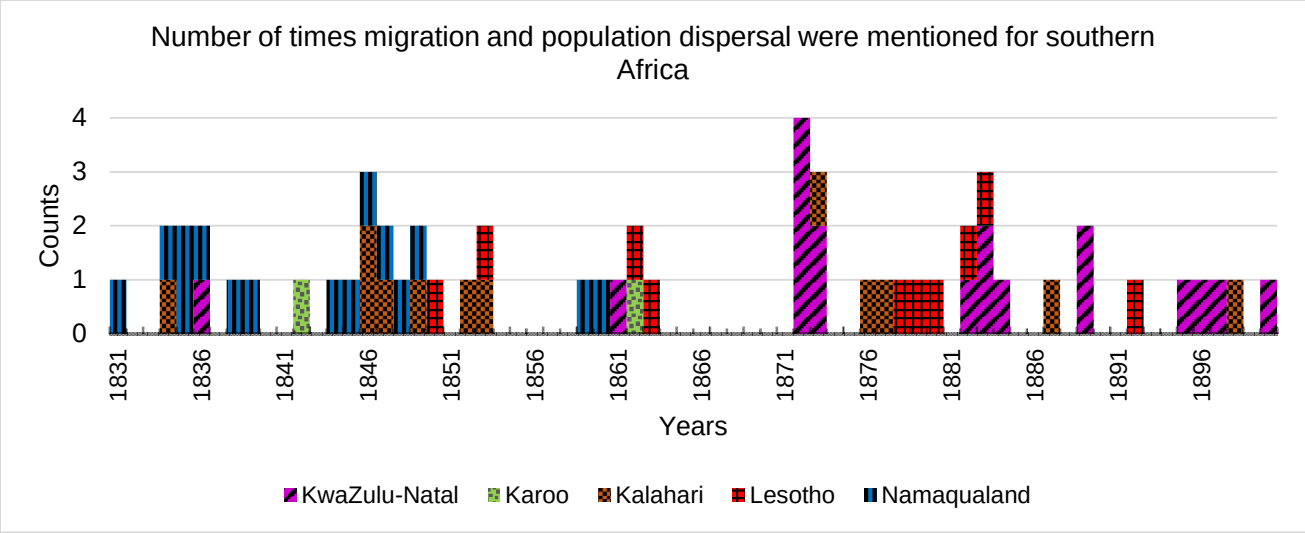

Figure 5-20: Documented migration and population dispersal in southern Africa

While documented remarks on the population of Namaqualand during 1839 revealed that the population reduced significantly, this was also a famine induced migration as indigenous people went in search for food elsewhere. This documented statement is further shown below:

"Mr. Schmelen describes the population of Namacqualand as being considerably reduced by an extensive migration to the eastward, which had recently taken place, and was still in progress at the time he wrote. This was in August last at which period the indigenous people were in much distress for want of food" (Report of the London Missionary Society, presented at the General Meeting of the Missionary Society, held May 9, 1839, 96-97).

Missionaries in Namaqualand felt that direct efforts should be made to stop people from living a migratory lifestyle, they should be encouraged to erect fixed homes and fixed places of worship (Reports of the LMS, 1838). The research outcomes by Kelso (2010) supports the findings for southern Africa during the 19th century as it reveals that missionaries often opposed transhumance practices, and often encouraged permanence. By 1860, there was no documented migration for Namaqualand, indicating that people migrated less after this year, while the effectiveness of transhumance practices recorded during this century could have been one of the factors that strengthened the ability of the Namaqua population to cope with droughts and lower their vulnerability to such fluctuations in climate (Kelso, 2010). In the long term, this livelihood strategy helped the Namaquas to possibly sustain themselves successfully (Kelso, 2010), which is why in the latter half of the 19th century there are not many documented cases of migration for this region. While people were still migrating in KwaZulu-Natal up until the 1900s, indicates that perhaps their vulnerability to famines and droughts were more severe and they had less adaptive capacity to cope with such effects. However, during 1896 in KwaZulu-Natal, despite famine and drought, migration was seen as an opportunity by mainly men and the youth to seek employment in the former 'Transvaal' and move away from a subsistence lifestyle (Missionsblatt 43/12,Hermannsburg 1896, 231-4). Other occurrences of migration in KwaZulu-Natal described indigenous people trying to recover from famine by migrating in search of work; a documented description of this is explained further:

From 1897, reports are saddened by the tribulations that are going on in South Africa. From Alfredia missionaries J.R. Roessler in Elim and H. Deppe in Marburg. Br. Roessler writes on July 12, 1897: "*Most of the male residents of the station were in order to recover from the aftermath of the famine and to be able to pay the debts incurred, away to work* (Missionsblatt 45/1, Hermannsburg 1898, 4-5). Migration also became less extensive in Lesotho by the year 1892, with documentary evidence for the Kalahari highlighting that migration ended by the year 1898.

5.7.2 Rainmaking

Traditional rainmaking was documented in the Kalahari, Lesotho and KwaZulu-Natal regions during the 19th century (Figure 5-21). Majority of the years in which rainmaking was

documented were classified as dry/very dry years, with the exception of the following classified wet years reported in Lesotho: 1840, 1843, and 1874 (Nash and Grab, 2010). Even though 1840 was described as a wet year in Lesotho, rains were possibly late which led to rainmaking occurring, while rainmaking was documented in 1843, it actually took place in 1842, in response to late rains and delayed crops in that year (Germond, R.C. (1967) Chronicles of Basutoland: a running commentary on the events of the years 1830-1902 by the French protestant missionaries in southern Africa. Morija Sesuto Book Depot, Morija, Lesotho). The year 1874, Lesotho experiencing a drought before the relatively wet period set in, but by December 1874 the long continued drought had broken up and Lesotho had abundant rains (Little Light of Basutoland No 12 December 1874). Prior to the rains occurring, rain making was conducted in November 1874, as described below:

p.3 "*There is also a superstition that people in high positions as Chiefs have power to make rain, and it was hoped by many that such a gathering would surely be the means of bringing down rain, which now is very much wanted: therefore the principle chiefs, at the conclusion of their speeches, exclaimed 'Rain!' 'Ask for Rain!' and all the people joined in the chorus 'Rain! Rain!*'" (Little Light of Basutoland No 11 November 1874).

Evidence describing the breaking up of the drought after rainmaking was recorded towards the end of 1874 and is described below:

p.4 [Articled called 'Rain.'] "The long continued drought is now fairly broken up, and Basutoland has been visited by abundant rains: for some description of cereals the blessing has come too late, but for those crops upon which the support of the people is mainly dependent, there is still sufficient time to prepare the land" (Little Light of Basutoland No 12 December 1874).

Relatively wet years were also reported in KwaZulu-Natal during 1855-56, while 1864 was classified as a very wet year with floods (Klein *et al*., 2016). Rainmaking was widely mentioned in Lesotho with 11 documented years. The earliest mention of rainmaking took place in Lesotho in 1833, with a missionary describing his observation of superstitious men making rain (PEMS AA FBN1 Mf.13. Lemue, P. Motito. 4 Décembre 1833). While rainmaking is an act that is religious and not scientifically proven attempts at making rain during the year 1840 in Lesotho appeared to have failed (WMMS SA CORRESPONDENCE FBN4 Mf 118, R. Giddy, Thaba Nchu, 28 December 1840).

"A short time since an attempt was made to get up a rain-making ceremony… But notwithstanding they used every effort to procure rain, not a drop fell on that day nor for six weeks afterwards" (PEMS AA FBN1 Mf.13. Lemue, P. Motito. 4 Décembre 1833).

Rainmaking practices in southern Africa often took the form of animal sacrifices; for example, in KwaZulu-Natal in 1851 oxen were sacrificed during traditional rainmaking ceremonies as an offering to God to produce rains (KCM 65607. GARDEN, Capt Robert Jones. Vol. 2: Copy of Miscellaneous Notes and Information 1851-1853). Rainmaking also involved invoking the ancestors or God, or sometimes both (Ombati, 2017).

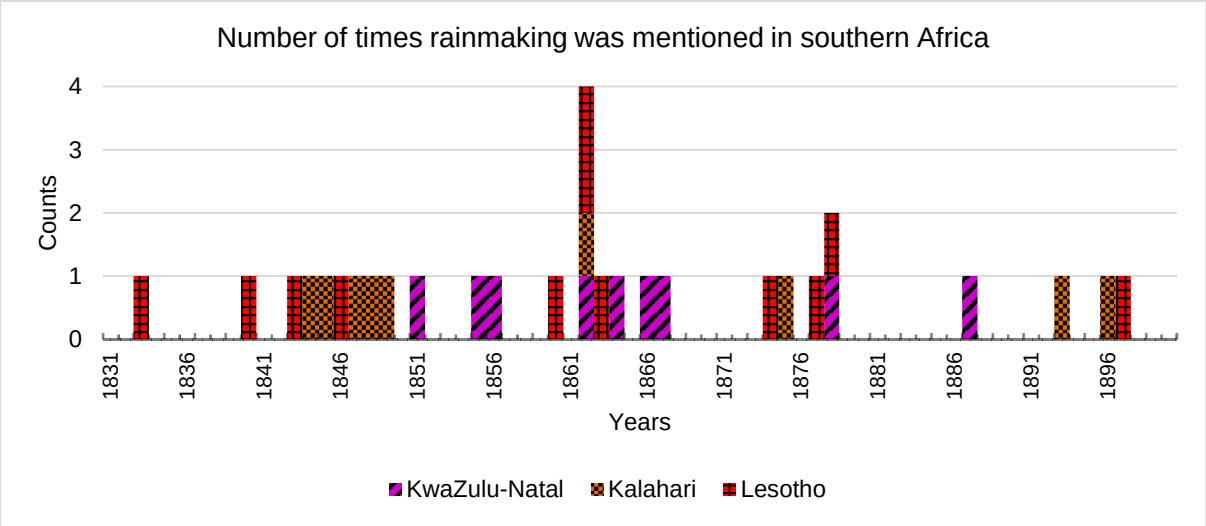

Figure 5-21: Documented rainmaking in southern Africa

Rainmaking was a tradition in regions like KwaZulu-Natal and proved to be a common form of prayer and sacrifice for rains. However, it was often disapproved of by the missionaries, with the act being labelled as a heathen, superstitious practice. Missionaries in southern Africa often believed that the act of rainmaking was regarded as superstitious, with descriptions of this indicated in KwaZulu-Natal below:

"*The rains this season are very late, and consequently people are not able to plant and everyone is becoming most anxious. The Amanwazi king is thought to be the great Rain Doctor in this part but he has just taken a number of wives and is said to want cattle to pay the ukulobola or marriage arrangement, so he refuses to give rain until the people have presented him with the requisite numbers of cattle. These superstitious ideas are one of the greatest difficulties in our way against being allowed to settle in the middle of the country. The chiefs know that we missionaries are men of peace and they often say we are very kind to them and help them when they ask for our aid. But they also know that the tendency of our teaching is to dispel these erroneous opinions and make the people look upon them as men and not as gods*"(USPG E31, J. Jackson, Amanvazi, Zululand, 31 October 1876).

"When we first commenced at Hlomisas it was the most heathenish place in this part of Zululand. The chief himself was one of the best known "Rain-doctors" in the whole of this upper district. In time of dearth it was generally to him that the people sent even from other tribes beseeching him to make rain for them. Even within the last two years he used to sacrifice to the "Amadhlizi" (i.e. the spirits of their departed ancestors) and call on them, and deceive himself and the people with the idea that it was the means of bringing rain. But gradually since this little station has been established and the Gospel has been preached he has desisted. Last year there was a great dearth of rain, it held off for so long that the cattle were dying in great numbers all over the country for want of grass and noone could do any planting although long past planting time, and messengers came to him from the neighbouring tribes asking him to make rain for them or they would die, but I am glad to say he resisted the temptation. Shortly afterwards, at his request, I came to hold a service, and found he had collected all his people together to ask for rain from the great God. (We had a special service here at St Augustine's about the same time, praying for rain" (USPG E42a, C. Johnson, St Augustine's, Zululand, 30 September 1887).

Similar accounts of heathenism and disapproval of rainmaking by missionaries have also been documented in Lesotho as follows:

"*At present, heathenism is rampant: witch doctoring, rain making, and the grossest sensualizing prevail everywhere. But we must be patient and pray on*" (SPG D48 (1878) Letter from Rev. J. Widdicombe, Thlotse Heights, 2 November 1878).

Despite what the missionaries thought of rainmaking, Zulu tribes regarded rainmaking as a sacred practice and by the year 1878 rainmaking still continued to take place during droughts in KwaZulu-Natal. Although missionaries believed that it was a superstitious act, documented evidence portrayed that rainmaking ceremonies during 1878 in KwaZulu-Natal resulted in a breaking up of a drought. Local indigenous people often worshipped and displayed their faith in the practice during droughts and towards rain doctors; this is highlighted below from the Natal Witness:

"*We are informed that just before the breakup of the drought last week, the Kafirs at the Umlaas had decided to offer a large fee to a rain-doctor there. He promised they should have rain soon, and by chance it came next day. In consequence, the indigenous people have more faith in rain-making than ever*" (Natal Witness, 14 November 1878).

Towards the 1880s and 1890s, rainmaking was documented less by missionaries. A possibility could be that missionaries and travellers didn't feel the need to report on rainmaking as often

as the beginning of the century. Although there were fewer documented records of rainmaking, it did not mean that rainmaking didn't occur during this period.

5.7.3 Prayer for rains

During most of the 19th century, prayers for rains were conducted as a religious environmental response in southern Africa. Such religious responses were documented mainly in KwaZulu-Natal and Lesotho. These rituals took place mainly during drought years, with the exception of 1830 which was classified as normal and 1832, for which there was insufficient evidence for Namaqualand (Kelso, 2010). The years 1886 and 1888-89 were also classified as normal years during which people prayed for rains in Lesotho (Nash and Grab, 2010). Prayer for rain was also viewed as a religious environmental response by individuals during the 19th century. People prayed for rain as a means of coping during periods of drought. In Namaqualand, the years in which communities prayed for rain were reported during 1830, 1832, 1844 and 1855. People also gave thanks to God during fruitful seasons, as reported by Shaw:

"*The Lord gives us rain and fruitful seasons, - how great is the goodness of God! We plough our fields and sow our seed, of which we knew nothing before we had the gospel; but now we know these things also*" (Shaw, 1970: 109).

Similar to the religious responses in southern Africa, Gerrard and Petley (2013) discuss that across modern Europe, prayer remains a common response to environmental hazards, whilst in medieval Christian Europe the perceptions of natural events were understood through bible readings and devotional messages. During 1844, there was incessant prayer for rain taking place in Namaqualand during a period of drought and distress:

"*We had continued incessant prayer for rain, hoping that God would be gracious. We were now called on by the goodness of our Heavenly Father to praise him for abundance of rain. In consequence of the drought, and the distress arising therefrom, I thought it would be well to seek help from God in prayer*" (Tindall, 1959, 57).

However, the findings by Grau-Satorras *et al. (*2016) stated that droughts were not the only reason for driving adaptive responses. Warfare and public debt influenced community responses to droughts and social insecurity in Spain. This resulted in warfare-led response such as religious measures and symbolic rituals to enhance social cohesion (Grau-Satorras *et al.,* 2016*).*

Prayer for rain continued during 1831-32 in Lesotho, years which were reported as being very dry (Nash and Grab, 2010). Reference made to a journal entry date 11 January 1832, described this as follows:

"*The people… prayed to God as they had been recommended and shortly after the heavens gathered black until the rain commenced which continued through the night"* (WMMS SA CORRESPONDENCE FBN3 Mf 80. J. Archbell, Plaatberg, 20 March 1831- 1832).

In addition, the price of food was described as being double than usual, compared to previous years. As a result of this, people requested meetings to pray for rain (WMMS SA CORRESPONDENCE FBN14 Mf 527. A. Brigg, Wittebergen, 3 August 1862).

In KwaZulu-Natal prayer for rains was also documented during periods of serious droughts. Some descriptive quotations describing these prayers are shown below:
"Morning service. I preached from 2.23 Job the first upon. We had had what threatened to be a serious drought, and at last the propriety of using the prayer for rain was suggested to me. This I did, and leaving had a plentiful and most grateful supply of rain. I today used the proper thanksgiving, and preached upon the subject" (USPG E9a, C. Grubb, Bishopstowe, 27 January 1862).

"*Drought. From Graham's Town we learn that prayers for rain were offered up in every place of worship in the city on Sunday, the 15th February, and special prayer meetings, which were well attended were held for the same object on the following day in several chapels* (Natal Witness 15 February 1867).

In 1867, prayers for rain took place over a day to overcome long continued drought, indigenous people were summoned to attend such religious offerings *(USPG E21, B. Markham,Umlazi, 30 September 1867*)
"The rains, which are descending in glorious showers now upon the parched ground, seemed rather protracted this season and caused some uneasiness to the natives. So they asked us to worship with renewed fervour and pray to the Lord for rain. They related an interesting incident in Dr Adams time. "Rain had not fallen for a long time and everything was parched and withered and famine seemed inevitable to the great distress of the natives. So Dr Adams appointed a day to pray for rain and summoned the people all round to attend. And well did they respond to it, many came a distance of over 30 miles to pray for rain, and sure enough it did rain, they all returned home in the rain fully believing that the Mhosi [?] had heard them and sent them rain! Last Sunday I had the chapel comfortably full... they had come here to

thank God for the rain and to seek his favour for the future, He was very gracious to give them rain" (USPG E21, B. Markham, Umlazi, 30 September 1867).

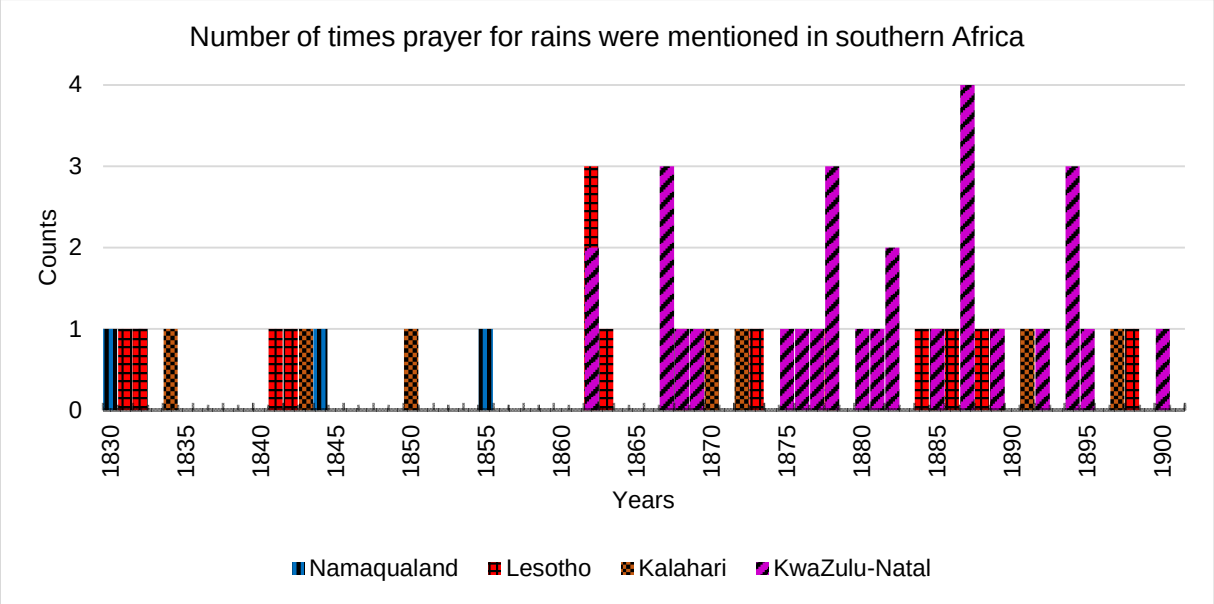

Figure 5-22: Documented religious response to droughts in southern Africa

5.7.4 Eating of wild food

Eating of wild food was regarded as a coping mechanism and was heavily relied upon during severe drought periods (Hannaford and Nash, 2016). Based on the findings by Hannaford and Nash (2016), such evidence was observed in southern Africa. Such wild food was documented to comprise of such things like berries, insects, roots, grass, leaves, and bulbs. The majority of the years in which eating of wild food took place were drought/dry periods in southern Africa, with the exception of the following years: relatively wet in Lesotho (1843 and 1892), unclassified in KwaZulu-Natal (1846), seasonal rains in KwaZulu-Natal (1851, 1867 and 1882) and normal years classified for Lesotho in the following years (1859 and 1866). The number of times that eating of wild food was mentioned in 19th century documents was 23 times in southern Africa (Figure 5-22). This occurred mainly in years during which there was mention of droughts and famines. Evidence for such occurrences when this took place indicated that people had to go in search for such food during desperation and hunger caused through droughts. Drought induced famines led to many difficulties and food security was a major concern during such times. In addition, food distribution was unequal and in such periods of famine and food scarcity, vulnerable communities who owned fewer cattle, were compelled to find wild food sources (Hannaford and Nash, 2016). In agricultural communities, drought induced crop failures have also impacted on harvesting in regions like KwaZulu-Natal during 1882 (USPG E37, J.M. Samuelson, St Paul's, Zululand, 30 September 1882). Such crop failures have also led to people consuming roots as a means of subsistence.

The most devastating periods when indigenous people consumed wild food was described in 1858 and 1896, during periods of terrible famine and long continued droughts in the Kalahari (LMS C 31-1-B.W. Ross Lekatlong, LMS C 53-1-B J.T. Brown Kuruman 27 February 1896). While such coping mechanisms were adopted earlier during the 1840s in KwaZulu-Natal and Namaqualand, people in the Kalahari started to adopt such coping strategies during 1850.

While people were compelled to consume roots during a period of famine, this took place over a long period of six months during which roots were consumed as a food source (LMS C 31-1-B W. Ross Lekatlong 1 November 1858). In addition, devastating occurrences of starvation in the Kalahari were documented in 1896, which forced people to consume roots, berries and insects (LMS C 53-1-B J.T. Brown Kuruman 27 February 1896). Long devastating droughts documented for the year 1873 in the Kalahari also resorted to indigenous people coping with such droughts through hunting and digging for roots and bulbs (LMS R Box 1 A.J. Wookey Kuruman 24 December 1873).

"*I must mention the long drought which broke up only a few days since. Previous to this, on rain had fallen for many months so that the country had become quite parched up. Fountains had become dry and for some time the people had been scattered seeking water and pasturage for their flocks and herds and, leaving the towns and villages almost empty. Many of them too, when the milk failed were compelled to go out, some to hunt, others to dig roots and bulbs on which to subsist, itinerating has been impossible as there has been neither food nor water for cattle. The aspect of things was becoming serious when the other morning we were gladdened by the sight of rain"* (LMS R Box 1 A.J. Wookey Kuruman 24 December 1873).

Famine conditions and prohibition of ploughing in KwaZulu-Natal were amongst some of the factors which resulted in indigenous people living off roots (Natal Witness, 25 September 1846). These conditions were further worsened by lack of rains and severe droughts; while similar problems were documented in Lesotho during 1859, with severe droughts resulting in harvest failures. Reports of the Thaba Nchu circuit (1859) for Lesotho described that conditions of severe droughts resulted in serious failure of harvest. An immediate response by the Basothos was the scattering of people in order to find subsistence through digging forroots in the region (WMMS SA Synod Minutes FBN2, Mf.66, Northern District Minutes and Reports, 26 Oct. 1859). This is described in the quotation below:

"In consequence of the severe drought which during the greater part of the year scourged this country, and ultimately caused a serious failure in the harvest, many of our people were scattered over the land in order to find a scanty subsistence by digging roots, catching half-starved game, or taking service among the Dutch farmers, who were themselves badly off for

food; during the Winter however, our members have nearly all returned to the station, where they continue to hold out, still contending with sickness and want"(WMMS SA Synod Minutes FBN2, Mf.66, Northern District Minutes and Reports, 26 Oct. 1859).

The seriousness of the drought and famine situation described in 1863 further increased the chances of a poor harvest, with late rains being unfavourable for the sowing of seeds.

"As in Lesotho in general, and more than in certain parts, we suffered from the extreme drought which reigned in these regions until lately, there was already a food shortage, it has resulted in a true famine. Our people do not have any sort of provisions to live. They only have a little dairy since the rains, because before the cattle, who did not yield any as result of lack of food, could hardly stay alive. Like after the war of 1858 the hunger pushes the people to eat roots to live. And what increases the seriousness of the situation is that they have the prospect of a poor harvestnext autumn, the rains having fallen so late that the seeds will not be able to become ripe" (PEMS AA FBN4 Mf.199. Cochet, L. J. Hébron. 6 Février 1863).

By 1884, the Basotho's were in a trying time of famine (PEMS LES FBN6 Mf.337. Kohler, F. Cana. 18 Novembre 1884). Food sources comprised of grasses and roots (PEMS LES FBN6 Mf.337. Kohler, F. Cana. 18 Novembre 1884). Basotho were also trying to use exchange of cattle for grain, however cattle were also in a weak condition due to droughts, and as such they were slaughtered as a food source to be shared amongst the indigenous people (PEMS LES FBN6 Mf.337. Kohler,F. Cana. 18 Novembre 1884).

Table 5-22: Documented cases of consumption of wild food in relation to droughts and famine in southern Africa

Region	Quotation	Reference
KwaZulu-Natal (1882)	"I were to give you a full account of the present state of the part of the country in which I am living it would not be very encouraging. The drought that commenced before last Christmas has continued hitherto without intermission, broken only by one or two light showers. There was no harvesting last season and now there is no planting because the ground is dry as ashes. The poor mothers and children have been subsisting on wild fruit, roots and herbs but they are done also as even the trees are drying up. Our gardens of bananas, pineapples, oranges [sic],citrons, peaches and guavas is going to ruin so we can no longer help them with fruit. It is very sad to see their skeleton forms begging for everything on Sundays after service. God does not seem to regard our prayers for rain but rather to have determined to pour out some	USPG E37, J.M. Samuelson, St Paul's, Zululand, 30 September 1882

	heavy judgment upon this poor land. Our Christians have been a little better off but they will also have hard times of it if it we do not soon get some moderate rain or showers"	
Lesotho (1866)	p.731 "now there is peace and quiet, and yet there are continual rumours of war and causes of disquietude in my country: the hunger, which has now become general, is causing daily great and many suffering among my people, though hitherto those that have stayed have been able to live a little upon grass and roots found in the field. I can assure Your Excellency that hunger is becoming more dreadful every day."	Sauer, J.W. and Theal, G.M. (1883) Basutoland Records: Copies of official documents of various kinds, accounts of travellers, *&c.* Vol. 3B 1865-1868. W.A. Richards and Sons, Cape Town**.**
Lesotho (1884)	Our Bassoutos are in a time of famine. A number of them have only grasses and roots which they prick from the meadow as food. Last year the harvest was above average but it would have been enough for the needs of the tribe if it had stayed in the country	PEMS LES FBN6 Mf.337. Kohler,F. Cana. 18 Novembre 1884.

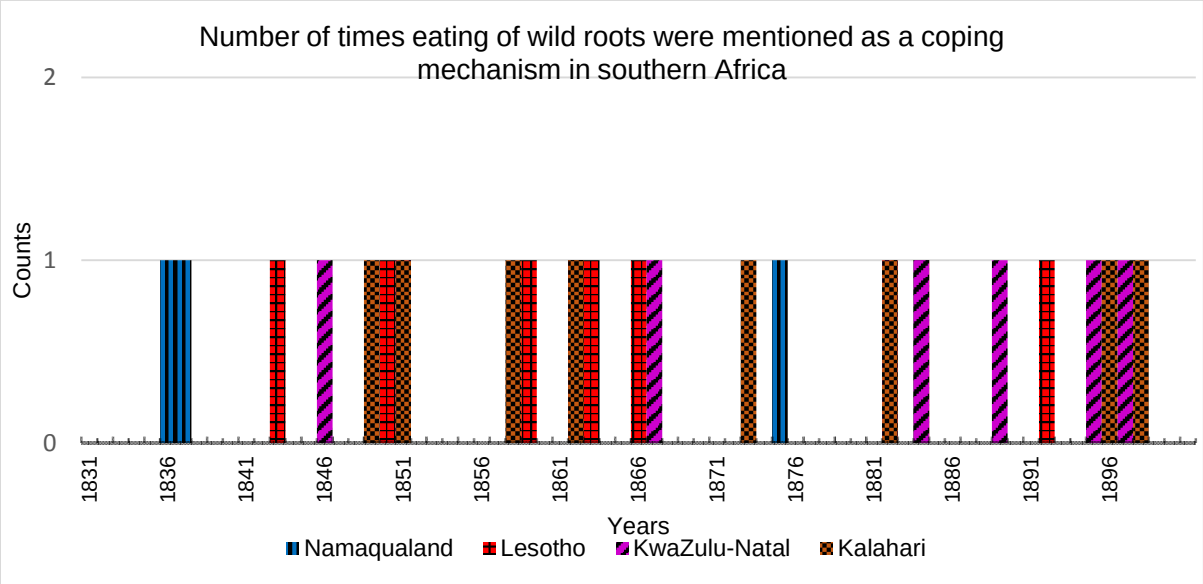

Figure 5-23: Documented cases of consumption of wild food in southern Africa

While consumption of roots in regions such as KwaZulu-Natal and Kalahari continued well into the end of the 19th century, consumption of wild foods in regions such as Lesotho and Namaqualand were not as widespread during the end of the 19th century. In Namaqualand the development of the mining industry towards the 1860s improved the situation in the region in terms of employment and cheapness of food (CCR, 1863). This could be a factor which resulted in people not resorting to eating wild food. The quote below could also indicate a period of recovery from such a situation:

"*The returns from the mines show that the works are being steadily carried on. The erection of smelting furnaces is being commenced. Crime has decreased. This is attributable to an*

increase in the quantity and cheapness of food, and to greater facility of getting employment. But many parties of Bushmen are roving about the division, refusing to work, stealing cattle and sheep, and doing much injury to the farmers" (CCR, 1863).

Despite the continuation of famines conditions in Lesotho, the Kalahari and KwaZulu-Natal until the end of the century, the consumption of wild food in Lesotho is last mentioned in 1892; while in KwaZulu-Natal the last mentioned occurrence of wild food in the region was in 1897; and in the Kalahari in 1898.

5.7.5 Digging for water

Digging for water was a simple coping mechanism practiced also during periods of severe droughts and water scarcity in southern Africa (Figure 5-24). This took place in all the regions in southern Africa during the 19th century, although it was documented to have occurred more times in Namaqualand compared to other regions. The total number of times digging for water was mentioned in southern Africa was 25 times (Figure 5-24). Such a technique used to obtain water during droughts described hand dug wells that were created to retain water during droughts. In Namaqualand, during 1836, a dreadful heat spell was documented and this indicated that due to the heat in Kowsie, indigenous people had difficulty in obtaining water (Alexander, 1967:123). Indigenous people were obtaining water through digging the ground, as described below:

"*We shot a couple of steenboks, but had great difficulty in getting water in the Kowsie at this time. We dug with our fingers in the sand, and got at last, by creeping on our hands and knees into a hole, some brackish and fetid water, to moisten our meat, with which we had neither bread not salt*" (Alexander, 1967: 123).

Similarly, during the years 1840, 1848 and 1851 indigenous people in Namaqualand were attempting at obtain water through digging river beds (Tindall, 1959, 14, Tindall, 1959, 125, Tindall, 1959, 151). In the year 1855, they were able to find little water through digging for some time; however the water was described as being so salty that it could not be used (Cape Times, 6 September 1895, The Great Thirstland: Namaqualand's Bitter Cry).

"These people dig small holes into the blue stones, which seve as reservoirs for such water as they can find. The water is brackish and ungrateful to the palate, but such as it is these poor people have none other to drink, and of that too little. Their cattle they have sent northwards into Damaraland, for here they must inevitably perish. Only a few horses have remained behind with their masters, and they are reduced by privation and consuming thirst

*to shadows; they are just alive, and that is about all – mere skin and bone, for flesh there is none" (*Cape Times, 6 September 1895, The Great Thirstland: Namaqualand's Bitter Cry).

In Namaqualand documented during 1859, water for domestic use was brought in by ship from Cape Town, and this cost a shilling for two gallons (one cent per litre) (Smalberger in Ross, 1996, C.121). Correspondence documented in the Cape Times during 1895, highlighted the poverty of the Boers, together with native dependents and whites. Indigenous farmers were at a plight, and abandoned their homesteads and trekked away to find water (Cape Times 6 September 1895). The Cape Times (6 September 1895) further reported the manner in which these farmers were trying to obtain water and described that they attempted at finding water by digging small holes into blue stones, which served as reservoirs, however the water was described as "brackish" and undrinkable. While trying to obtain water, some of them sent their cattle northwards into Damaraland as they were in a poor physical state (Cape Times 6 September 1895).

The search for water in Lesotho during 1832-33 was a result of water shortages/scarcity which did not satisfy the needs of the population (PEMS AA FBN1 Mf.13. Lemue, P. Motito. 1er Janvier 1833). Inhabitants travelled great distances to obtain adequate water for themselves and their stock (PEMS AA FBN1 Mf.13. Lemue, P. Motito. 1er Janvier 1833).

"*Travelled to see if we could not find water more abundant than Morija. Sirs you ask why. This is because one of our springs has dried up so much that there is very little water for a station*" (PEMS AA FBN1 Mf.17. Gosselin, C. Morija. 24 Avril 1834**).**

The need for water in Lesotho during 1862 further resulted in people adapting by migrating from their present village in Molape to the mountain of Leribe in search of water elsewhere:

The want of water, and other difficulties at Molapo's village, obliged them in 1862 to leave their cottage, and betake themselves to the present site of the station close under the mountain of Leribe (MacIntosh, C.W. (1907) Coillard of the Zambesi. Fisher Unwin, London).

In 1860, KwaZulu-Natal experienced a period of droughts and consequently people had to obtain water from very far, and were restricted to a few buckets a day, which impacted on the production of clay for building purposes (USPG E7, A. Tonnesen, Umgababa, Lower Umkomosi, 1 August 1860). A year later in the Karoo (1861) water was obtained from wells having a depth of 20-30 ft. (Cape of Good Hope (Colony) Blue Books. Cape Town, Richards. P.JJ 27 Year of 1861 *Appendix*: Burgersdorp). In addition, farmers were obliged to leave with their stock to Zuurberg, where water was procurable at all times (Cape of Good Hope (Colony)

Blue Books. Cape Town, Richards. P.JJ 21 Year of 1861 *Appendix*: Somerset). Water was the main draw back for farmers, and during 1865 farmers were digging for the want of water.

Indigenous people in the Kalahari region tried finding water in the Gamolopo River during 1857, however this proved to be unsuccessful, as described below:

"*Yesterday we searched the Gamolopo River shortly after 4 O'clock. Hoping to find water, two men started with the oxen and sheep towards the water said to be higher than the river bed. About an hour after dark, they returned, not having reached the water*" (LMS J Box 4, 115 R. Moffat Huarira Pool 6 August 1857).

During 1867, indigenous people travelled west to Kuruman with the weather described as exceedingly hot with the want of much rains (river (LMS C 34-3-A R. Moffat Kuruman June 16 1867). Travellers directed their course to the northwest towards Nokaneng, a river bed to obtain water by digging pits in the bed of the river (LMS C 34-3-A R. Moffat Kuruman June 16 1867). The state of the landscape in the Kalahari during 1886 is further described as very dry by missionary A.J Wookey (LMS C 44-1-D A.J. Wookey Molepolole 17 May 1886). The impacts of such dry weather have affected the gardens in the region. Attempts are therefore made at coping with water scarcity through the digging of well, as described:

"*The country up here is getting very dry. We have no water for the garden. You remember the trees which Mr. Price had in his garden, the look very bad now. I have partly dug a well, which has a little water, but needs to be depressed considerably*" (LMS C 44-1-D A.J. Wookey Molepolole 17 May 1886).

Further references were made to the dry state of the Kalahari region in 1898, with fountains described as stagnant, and desiccated (LMS C 55-2-D J. Good Kanye 11 November 1898). The indigenous people have dug ten to twelve feet to obtain drinking water during such a drought period:

"You know how long I have been here at Kanye have never seen any such dryness before... our fountains have ceased to flow and we have had to dig ten or twelve feet to get drinking water.. I hope we will have rain soon or the people will be in most terrible straights. A few weeks and the plowing season will be past + how will they exist another year I don't know" (LMS C 55-2-D J. Good Kanye 11 November 1898).

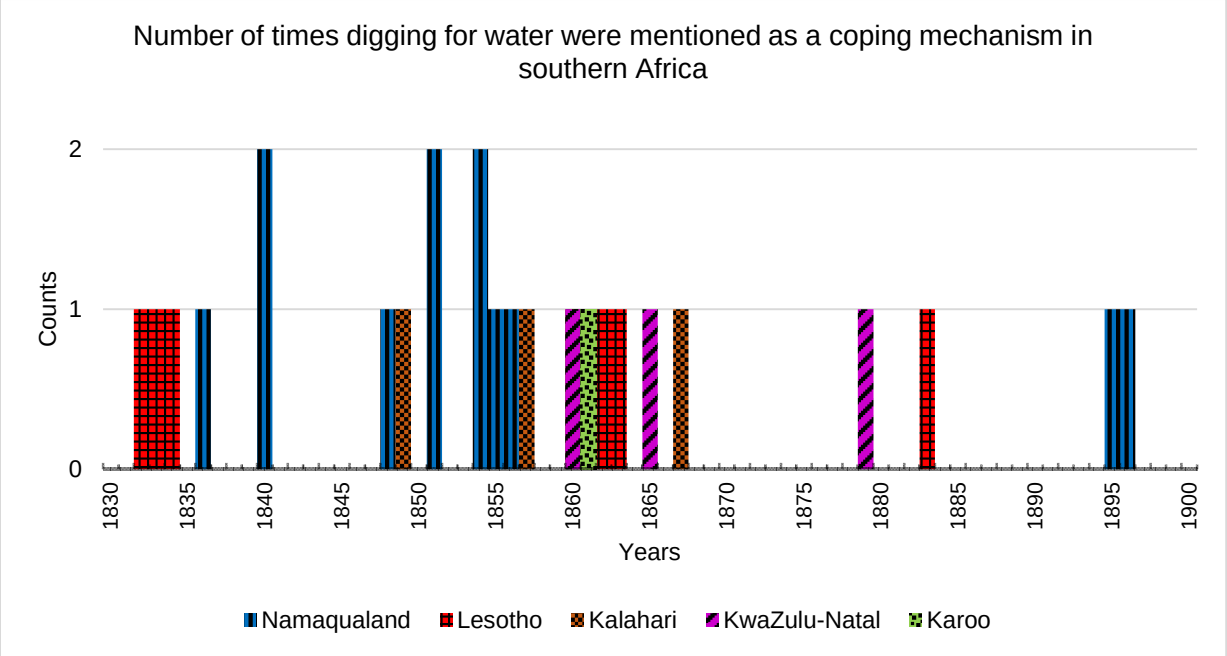

Figure 5-24: Documented cases of drought responses in southern Africa

5.7.6 Changes in agro-pastoral practices /landscape changes

Changes in agro-pastoral practices may be a form of adaption to climate impacts in the agricultural sector. According to Azibo *et al*. (2016), rural communities have become the main arguments for climate adaptation, specifically within the agricultural sector. This is due to the fact that their significant involvement in agro-pastoral activities remains the main source of livelihoods in southern Africa (Azibo *et al*., 2016). Changes in agro-pastoral practices serve as common adaptive responses to climatic changes, which include for example: livestock changes (introduction of new breeds), behavioural changes (reduced consumption), managerial (new approaches to farming techniques) and policy aspects (regulations) (Silvestri *et al*., 2012).

Changes in agro-pastoral processes were observed for the Kalahari (1854), Namaqualand and the Karoo (1858), Lesotho (1898) and KwaZulu-Natal (1852, 1860, 1865, 1872 and 1897). Irrigation can be seen as a water resource management technique to address risks associated with excess rains and increased drought frequencies (Smit and Skinner, 2002). The adaptation techniques involving irrigation for the Kalahari region in 1854 was described below.

"*The advantages of irrigation were perceived and the most enterprising sought out fountains in the country around for that purpose. But in addition to this the rains have for some years past been scanty and the harvests have failed…. The temporal circumstances of the people are now I trust improving. Their harvests seem more promising than it has done for some*

years past, the pasturage has become more abundant and when the reservoir… is completed the station will possess a stability which it has never hitherto attained." (LMS C 29-1-A H. Helmor Lekatlong 23 January 1854).

Similar to that reported for the Kalahari during 1854, irrigation was also viewed as a traditional adaptation measure that allowed for a reduction in short-term vulnerability to droughts in Mexico (Liverman, 1999). Amongst other responses to drought, migration played an important role in Mexico, with farmers abandoning their lands during a drought to find work elsewhere or across the United States (Liverman, 1999). Adaptation to agriculture can involve modification in production systems, which includes increased diversification and engaging in activities which are drought tolerant and resistant to temperature increases (Azibo *et al*., 2016). During 1858 in Namaqualand, the use of a threshing and reaping machine was introduced to white farmers in order to improve agricultural production in the area (CCR, 1858). Whilst the same year in the Karoo, farmers have adopted various irrigation schemes through means of blasting, forming extensive dams and banks for rain water retention (Cape of Good Hope (Colony) Blue Books, Cape Town, Richards. P.FF5 Observations by Civil Commissioners). This method demonstrated to be successful in the Karoo as documented evidence highlighted that large bodies of water were collected and this enabled farmers to irrigate extensive plots of land on the ground (Cape of Good Hope (Colony) Blue Books, Cape Town, Richards. P.FF5 Observations by Civil Commissioners). These are significant measures in order to farm better during droughts and periods of water scarcity. In order to prepare for the winter, efforts were made in KwaZulu-Natal during 1852 to keep cattle in good condition until the next season, through hay stacking, which was mentioned as a coping technique (Natal Witness 28 May 1852). This indicates the indigenous people in southern Africa prepared in advance for seasonal changes in order to ensure resource availability. A dry spell reported for the year 1899 in KwaZulu-Natal further resulted in the interrogation of irrigation systems specifically by farmers; such techniques are further described below:

Oliver's Hoek. The dry weather is still extraordinary and even phenomenal. On some farms cold showers have fallen, and the crops and grass there are all that could be wished for; on other farms, everything has the appearance of mid-winter. Under such circumstances, and after the experience of last season, it is not strange that irrigation is talked and thought of, and some of the more energetic farmers are striking out in this direction. The Tugela River has been taken out in two places onto files belonging to residents, by an energetic Cape Boer. The Lombonga River has also been taken out on land bought from the government by the same family. (Natal Witness 10 January 1899).

In KwaZulu-Natal, missionaries were exploring different techniques that involved landscape changes such as irrigation and tree planting (USPG E7, A. Tonnesen, Umgababa, Lower Umkomosi, 1 October 1860). Such landscape techniques were adopted during periods of heavy rains in the year 1860 to lead water down from the River Umgihaba (USPG E7, A. Tonnesen, Umgababa, Lower Umkomosi, 1 October 1860).

Late rains in September in KwaZulu-Natal had delayed planting and due to the migration of people in 1872, there were fewer people on the farm who could work with little food for them. Missionaries reported that they had purchased a plough harrow at £9 (USPG E28, J.M. Samuelson, St Pauls, Zululand, 30 September 1873). Similarly in 1898, Phelps, Fidelia, Inanda seminary, reported for June 1897 to June 1898:

"*As usual there was falling off in numbers towards the close of the first term [starting c. August, ending c. December] as the planting season came on. The claims of the parents were increased this time because the cattle had died with rinderpest and the ploughing must be done with picks [sic]. This meant of course that the girls and women must do all the ploughing this year, for though men and boys may guide the plough to drive the oxen; the woman only must use the pics or hoes. [...] The falling off in numbers for this reason was chiefly among the kraal girls primary department*". (ABC 15.4. vol. 13 (A 467, 188, 93).

5.8 Summary of key findings

Through the detailed analysis of existing historical projects and using existing data collected for Namaqualand, Kalahari, Karoo, KwaZulu-Natal and Lesotho, various social consequences as a result of weather related constraints were impacting the several regions during the 19th century. Various diseases were also mentioned in the 19th century namely smallpox, measles, typhoid fever, and dysentery. Although there were some forms of coping with such diseases, some diseases brought about many hardships for those indigenous people who have never encountered such diseases before.

Locusts were widely affecting southern African regions during the 19th century with the most devastating impacts to crops and pastures. Throughout the 19thcentury there was mention of locust impacts, however particular increase in locust outbreaks were documented towards the beginning of the 1890s. The impacts of locusts were devastating to agricultural communities in southern Africa, and outbreaks were widespread.

Diseases such as rinderpest, lung sickness and horse sickness were not widespread in the regions of southern Africa prior to the 19th century. Horse sicknesses were the earliest disease to have been reported in written documents, starting in the 1840s, followed by lung sicknesses

in cattle occurring from the 1850s and towards the latter end of the century, then later rinderpest annihilated much of the cattle population in southern Africa. Although widespread impacts were losses to livestock during such mentioned disease outbreaks, other forms of cumulative impacts were also recorded and compared for different regions across southern Africa. In addition, different forms of coping mechanisms were employed during such periods of losses.

The description of poverty during the 19th century also indicated periods of hardships and stress for southern Africa. Poverty was mainly associated with periods of hardships and stress for southern Africa. Poverty was mainly associated with drought periods. During drought years, indigenous people were already suffering from resource shortages associated with droughts and these included food shortages, cattle demises, along with hunger, sicknesses and crop failures. Some forms miscellaneous government responses were offered to communities in regions like the Kalahari and Namaqualand.

In responding to weather extremes and periods of climatic variability, indigenous communities were finding different coping and adaptation interventions to overcome such challenges. Miscellaneous religious responses such as prayer for rains and traditional rainmaking ceremonies were quite notable during the 19th century. These forms of religious coping mechanisms were also somewhat similar, although rainmaking often involved the sacrifice of an animal to the ancestors.

6 Overarching discussion



6.1 Introduction

The primary aim of this study was to use 19th century chronologies that have already been established for southern Africa to determine various environmental and societal consequences that followed droughts and floods including El Niño and La Niña years where this is recorded. This study also provided a comparative investigation of such consequences in the various sub-regions. In addition, various responses were also discussed in relation to these consequences. This contributes to the knowledge gap which had not previously been done for the region. Across southern Africa, it has also been noted that droughts were extreme and often lead to some of the societal impacts and notable consequences for the region. Such impacts included famines, inflation, poverty, while certain human diseases were also documented to be caused during periods of excessive droughts and lack of rains.

6.1.1 Human diseases

This study assesses the climate related societal consequences and responses during the 19th century for various regions in southern Africa. The major findings of this study indicate that in most cases of disease outbreaks in southern Africa, they coincided with widespread drought, famine outbreaks, and water scarcity. Although such widespread droughts and famines were not the particular cause of disease outbreaks in southern Africa, they made indigenous communities with low adaptive capacity and resources more vulnerable to such diseases. Particular diseases were intensified by drought and famine; for example, dysentery outbreaks in the 1860s which worsened in KwaZulu-Natal and the Kalahari during a major drought period when resources were scarce. Notable periods of famines were not just widespread during periods of drought but also during very wet periods or seasonal rains associated with the occurrences of crop failures. Prominent periods during the 1870s and 1880s in KwaZulu-Natal indicated these trends.

Diseases such as dysentery were not widely reported across all regions. The few documented cases highlighted that KwaZulu-Natal was affected the most by it. The trends in the documented data also indicated that KwaZulu-Natal struggled to recover from dysentery which persisted from 1893-1897. While fewer cases of dysentery were reported for regions such as the Karoo and Kalahari, these regions recovered quickly from the disease. Regions such as Namaqualand and Lesotho were not documented to have had dysentery outbreaks during the 19th century, which does not imply that it did not occur there, but rather that it was possibly not recorded by missionaries due to few cases of it occurring, or it may have not been as widespread or serious enough to report on. The particular outbreak of dysentery in 1862 in the Kalahari was devastating and stood out as severe. Severe drought conditions experienced in the Kalahari during 1862 coincided with an El Niño which may have also had an effect on diseases and resulting in overwhelming rates of famine. Literature by Wylie (2001) also highlights that some diseases were caused by a combination of circumstances such a drought and locusts, which supports the findings of this research.

Even though 1862 was documented as a difficult year, the Kalahari region made a quick recovery from the disease, with no mentioned cases until four years later. While disease such as smallpox was relatively evenly spread across the different years, there were no persistent cases of the disease in the mentioned regions in which it happened (KwaZulu-Natal, Kalahari, Karoo and Lesotho). The disease appeared to be well controlled through interventions such as precautionary measures, involving vaccinations. By the year 1894, numerous amounts of vaccinations were taking place amongst the population in KwaZulu-Natal. By the end of the century there were no further cases of smallpox, which phased out due to such measures

being taken. Like smallpox, measles was not very common during the 19th century, with the few documented cases of it being in the Karoo, Namaqualand, Lesotho and KwaZulu-Natal regions. Measles was also not recorded as much, although there were few cases of it reported in regions such as Lesotho, Namaqualand, the Karoo and KwaZulu-Natal, but was recorded more than once in the Karoo and KwaZulu-Natal regions. However this does not imply that regions such as the Kalahari did not have measles outbreaks. Measles also broke out in 1860 in the Karoo, the same year in which smallpox occurred, however in 1861 smallpox was not documented in the Karoo, but measles continued for another year until the region recovered from it by 1862 and no further impacts were recorded. It is noteworthy to report that the majority of measles outbreaks in southern Africa occurred during relatively wet periods or normal rainfall years in the Karoo. However, the 1895 measles outbreak in KwaZulu-Natal was during a drought year. Ferrinho (1993) also found that variations of measles occurrences are also seasonal in South Africa, with outbreaks occurring in both dry and wet seasons; which is the same trend found in southern Africa.

6.1.2 Droughts, famines and economic effects

In the 1860s, the most common response to famines in KwaZulu-Natal, was population dispersal. Although population dispersal has been mentioned in the Kalahari region, once as a coping mechanism, it remained an immediate, common, persistent drought/famine/water shortage response in KwaZulu-Natal / Lesotho during the 19th century. Famines were also linked with poor harvests/low crop yields for most regions. Recorded famines in southern Africa showed that it lasted until the end of the century and was recorded in the majority of the years with the exception of the following years, 1830, 1832, 1834-1835, 1844, 1848, 1851-1855 and 1874 during which there were no documented famine cases.

Agricultural communities are also proven to be more susceptible to the effects and impacts of drought conditions because of their direct dependence on local harvest for subsistence (Ballard, 1986).Climatic changes and weather extremes such as droughts had a stressful impact on the indigenous communities in southern Africa. Recurrent droughts were not only applicable to the winter rainfall regions in southern Africa, such as the Karoo, Namaqualand and Kalahari, but also to the summer rainfall regions such as KwaZulu-Natal (Ballard, 1986), as shown from the documented cases of drought occurrences in southern Africa. Regions such as Lesotho are subject to periodic droughts which also resulted in food security issues and famine conditions (Eldredge, 2007). Research by Wylie (2001) highlights that famines were often linked to droughts, cattle diseases and locust outbreaks. This research related to these findings, in that the documented evidence for southern Africa shows similar trends. In addition, the worst impacts as a result of famines affecting all regions were the prices of food.

Inflation was a major setback for southern Africa during periods of famine/droughts. Famine prices were notably high, with more documented cases of it reported in the 1860s, and the Karoo region having the most documented cases, particularly in the years 1861-1862, which were classified drought years (Lupini, 2015). The spike in high prices recorded in the Karoo during 1861-1862 was also due to the bad supply of labour markets on account of droughts (Cape of Good Hope (Colony) Blue Books. Cape Town, Richards. P. JJ 23: Year of 1861 Appendix: Graaff-Reinet).Of the mentioned commodities that ranked at high famine prices, the common essential commodities affected by inflation prices were grain/seeds, forage, bread, vegetables, flour, crops and corn, which native populations depended on the most, as some of these were staple crops/food resources. Common linkages with droughts and crop failures were also mentioned as being responsible for high inflated prices of commodities; these were the most common reason as to why basic provisions and food items increased in price.

Although migration was an immediate adaptation response for some regions, it was also seen as a distress in that indigenous people had to leave their homes involuntarily, and seek work/food elsewhere. It almost implied that migration took place out of desperation and people were compelled to relocate in such uncertain circumstances. In some of the regions, like Lesotho, it was recorded as a negative act with the colony described as being a desert (WMMS SA Synod Minutes FBN4, Mf.186, Bloemfontein District Minutes and Reports, 18 Jan. 1878 Report of the Thaba Nchu Circuit for the year 1877). In regions like Lesotho and KwaZulu-Natal, factors such as war and droughts were often the link to some of the mentioned famines. While regions such as the Karoo and Namaqualand did not have widespread documented cases of famines, the most extensive cases of famine were documented in KwaZulu-Natal and Lesotho. By the 1900s, KwaZulu-Natal still had documented cases of famine, implying that it took longer for KwaZulu-Natal to recover from the famines. Famine could have well continued after the year 1900for KwaZulu-Natal, whereas cases of famines for other regions such as the Kalahari and Lesotho were recorded up until 1898-99, and there were fewer documented cases of famine taking place, which means it was not as widespread and therefore easier for these regions to recover quickly. The highest number of cases of famine documented,(a total count of 27) were recorded in KwaZulu-Natal during 1896, a year that the region was also experiencing the negative effects of dysentery, rinderpest, water scarcity, locusts, crop failures, and lung sicknesses. This also means that the hardships caused by these other problems, made it difficult for KwaZulu-Natal to recover from the devastations of famine.

Water is an important natural resource, particularly within agricultural communities in southern Africa. Such communities are dependent on seasonal rainfall for harvesting and reaping of crops. Water scarcity was portrayed as one of the most severe impacts of the 19th century, with most years documented to have water scarcity with the exception of the following 13 years: 1831-1832, 1835, 1839-1840, 1845, 1852, 1865, 1868, 1871, 1881, 1891, and 1899. Its impacts were felt greatly across all regions; however the most documented cases were in KwaZulu-Natal, Namaqualand and the Kalahari regions.

6.1.3 Locusts

Locust outbreaks that were documented across southern Africa showed that the most devastating effects were crop failures and destruction to grass pastures throughout the 19th century. Diversification and introduction of crops into southern Africa during the 19th century could have been the reason for such wide expansion of locust outbreaks (Ballard, 1983). However, locust outbreaks were often coupled and linked with droughts, famines, and diseases which made native populations increasingly vulnerable and their ability to cope more difficult. The years in which locusts were reported were often years in which regions were already facing terrible droughts, famine, hunger, illnesses and even deaths. For example, KwaZulu-Natal was faced with severe locust outbreaks during 1895 (S.M. Samuelson, St Paul's, Zululand, 31 March 1895Harvard) but the region was also facing outbreaks of grass scarcity, famine (USPG E50d, S.M. Samuelson, St Paul's, Zululand, 30 June1895Harvard, Houghton Library, ABC 15.4, vol. 13, Southern Africa, Zulu Mission 1890-99,) and rinderpest (Missionsblad 23. årg. no 6 Juni 1899 Hans Astup, (udatert)). Locusts persisted in KwaZulu-Natal into 1896-1897 and during these years documented evidence revealed that the region was also facing the devastating impacts of dysentery, rinderpest, famine, grass scarcity and even water scarcity was recorded in 1896. Although locust outbreaks persisted until the year 1900 in KwaZulu-Natal, it is understandable that the region was in crisis due to the effects of other impacts, and therefore the region was facing more difficulty in coping and recovering from rinderpest. In comparing KwaZulu-Natal to the Kalahari region, documented data showed that by 1898, locust outbreaks were fewer in the Kalahari than in KwaZulu-Natal, while in Lesotho crops production were affected by locust outbreaks,which continued until 1899 until the region recovered by 1900. These findings are similar to that of Eldredge (2007), who also revealed that the years 1892-1898 were devastatingly impacted by locusts and droughts in Lesotho. The persistence of locusts In KwaZulu-Natal until the late 19th century, could be attributed to the fact that black farmers grew a narrow range of food crops such as maize and sorghum in order to satisfy basic survival requirements, however, such a narrow agricultural base was greatly affected by locusts as compared to the white farming sector which contained

diversified crop growth making it more resistant (Ballard, 1983). A narrow crop base therefore proved to be less resilient toward locust impacts.

In the Kalahari region, particular reference is made in 1896 on the impact of locusts on corn crops, while no other crop varieties were recorded to be impacted by locusts in this region (LMS C 53-1-C H. Williams Molepolole 27 March 1896). Food scarcity in KwaZulu-Natal was widely documented in the years during which locusts were documented to have affected the region. In the early 1850s, intervention methods in the Kalahari were religious responses such as prayers for protection from locusts, while such mention of prayers were reported only in the 1890s in KwaZulu-Natal during which the intensity of outbreaks were severe and extensive in Natal. A widespread outbreak of locusts recorded, particularly during 1867 in Namaqualand coincided with an El Niño event (Kelso, 2010). That particular year, the region faced severe droughts coupled with locusts.

6.1.4 Livestock diseases

Rinderpest was affecting southern Africa greatly during the 1890s (van Onselen, 1972; Ballard, 1983). The results of this study is similar to the literature by van Onselen (1097) which showed that the rinderpest started in 1895 in KwaZulu-Natal and slowly spread into the Kalahari, Lesotho and Namaqualand regions by the year 1896. The findings of this study are consistent with that by van Onselen (1972) which showed that cattle losses due to livestock diseases were not only important to the economy, but for farming communities cattle ownership was a symbol of wealth and remains a crucial component of the social and economic system. The findings of this research further presented that during the 1860s and 1870s, southern Africa was faced with major outbreaks in lung sicknesses which lasted for ten years from 1855 until 1865, and then for another five years from 1869 until 1874. Of particular importance were the outbreaks during 1855 and 1856, during which there were the most documented cases of lung sicknesses taking place, and all regions except Lesotho were documented to be affected by these outbreaks. The increase of outbreaks during these years, were also in the years during which lung sickness was introduced into the region via trade routes through the Cape (Thiaucourt, 2004). Being a relatively “unfamiliar and new” disease, lung sickness was a dreadful disease that appeared to be spreading fast into the region. However, it does not mean that Lesotho was unaffected by rinderpest, as the disease was documented later during the year 1869. The increase in documented cases of lung sickness for Namaqualand could have also been due to the opening of the copper mine during which there were cattle in great numbers that were being used for transportation of copper from the mines. This could also be a reason for the spread of lung sickness, due to greater movement of cattle during this period that were also being used for the transport of copper (Kelso, 2010).

However, lung sickness also had great economic repercussion for the mining economy, with copper carriage being very dependent on cattle for transportation, the lung sickness devastated cattle in numbers which made copper carriage unprofitable and this impacted greatly on the local economy in Namaqualand (Civil Commissioner Report, 1865).

Rinderpest was documented to have had huge impacts to the transport system in regions such as Lesotho during 1897 (SPG E52b 1897 Report of Rev. J. Widdicombe, Thlotse Heights, for the quarter ending 30 June 1897), and KwaZulu-Natal during 1899 (Missionsblad 23. årg. no 6 Juni 1899 Hans Astup, (udatert)). In both of these regions, rinderpest outbreaks affected the cost of transport, which is also similar to the literature by van Onselen (1972) which stated that the outbreaks of rinderpest in the Cape during 1897 resulted in transport drivers having to pay substantial prices for mules to replace oxen during rinderpest outbreaks.

The 1855-1856 widespread drought conditions in Namaqualand resulted in greater transhumance practices in the region (Extract of a Letter from the Rev. Richard Ridgill, dated Nisbett-Bath, March 13th, 1856.Missionary Notices, 1856, 164), which could have also been a factor that resulted in the spread of lung sickness regionally. Whereas transhumance practices were not taking place in other regions, like the Karoo, Kalahari and KwaZulu-Natal, these regions were also vulnerable to cross border cattle movements and cattle trekking which could have brought the disease into the regions. By the 1860s, the disease appeared to be less documented in regions such as the Kalahari, Karoo and Namaqualand. KwaZulu-Natal was facing the disease until the year 1889, which means it took a while for this region to recover. During early outbreaks of the disease, immediate forms of coping with rinderpest started in the Kalahari region with food substitution being carried out by indigenous people in the region (LMS C 32-1-AW.Ashton Kuruman 3 October 1860).

What is interesting to note was that outbreaks lasted only for six consecutive years and were only recorded from 1895-1900 with the most outbreaks recorded during 1897 in KwaZulu-Natal. The literature from Ballard (1983) highlighted that the spread of rinderpest could have been a result of trek oxen entering Harrismith town-lands on the Natal-Free State border, and the Natal government was alerted of rinderpest well in advance of its arrival in KwaZulu-Natal. Despite such early warning to the Natal government, the disease still appeared in the region as early as 1895. The findings of the research by Ballard (983) further pointed out that white farmers were immediately taking precaution by attending meetings and rinderpest conferences in 1896, however no remedies were of use, and rinderpest already started resulting in the death of cattle in the region. These findings by Ballard (1983) are consistent with the results of this study which showed that rinderpest outbreaks increased by 1896. This

is probably due to the fact that certain measures were unsuccessful in controlling the disease or by the time rinderpest spread into KwaZulu-Natal it was quickly affecting cattle in large numbers which explains why the years 1896 and 1897 had the highest number of documented cases of rinderpest for the KwaZulu-Natal region.

It appeared that KwaZulu-Natal had the most documented cases of rinderpest, amongst the other regions which were affected such as Lesotho and the Kalahari. Rinderpest was not documented during years which were wet, and in most instances the disease appeared in relatively dry/drought years. While the affected regions were trying to cope with the difficulty of drought impacts, the rinderpest outbreaks further devastated some regions more than it did others. Documented evidence presented also showed that KwaZulu-Natal took a longer time to recover from rinderpest, whereas in regions such as the Kalahari, rinderpest appeared for three consecutive years from 1896-1898 until there were no documented cases, while in Namaqualand, rinderpest occurred only from 1896-1897 until there were no further documented cases (Figure 6-1).

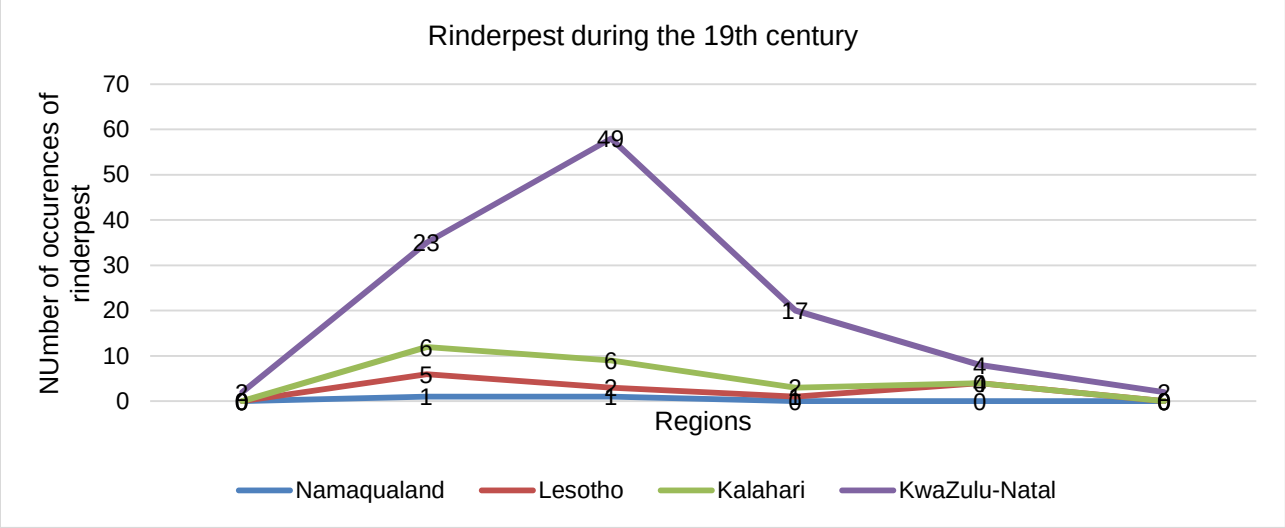

Figure 6-1: Line graph indicating the recovery of rinderpest from 1895-1900 in southern Africa

The majority of the years in which rinderpest took place were either classified as relatively dry or very dry/drought years. Such dry/drought years also presented other conditions such as unavailability of resources such as food and water, which hampered the ability of livestock to cope with disease outbreaks like rinderpest. The climate described for the years during which lung sickness took place, shows that 36% of the years was a dry/drought year during which lung sickness affected cattle, whilst 19% of the impacted years were wet periods. During wet periods, the spread of the disease could mean that infected cattle were migrating to areas where resources were available, through transhumance practices, whilst changing environmental conditions during drought years could also indicate that harsh outbreaks of lung sickness made it even harder for cattle to adapt.

Outbreaks of horse sickness also showed many fatalities amongst horses during the 1840-49 and 1890-1900 periods. During the 19th century horses were important means of transporting goods and people in southern Africa. The appearance of horse sickness took place in relatively dry/warm periods followed by wet periods, which also coincided with the work of Quan (2004) who indicated such patterns flourished the occurrence of horse sickness outbreaks. The cumulative impacts of horse sickness were devastating mainly towards transport in most of the regions.

6.1.5 19th century adaptation and coping in southern Africa

While various forms of adaptation and coping interventions were practiced during the 19th century, prayer for rains and migration were the most common forms of adaptation in KwaZulu-Natal, compared to the Namaqualand region were digging for water and migration during droughts were important forms of coping and adapting. Prayer for rains were widely adopted by the Basotho and Zulu cultures, and in Lesotho rainmaking was the most practiced coping mechanism compared to other regions (Figure 6-2).

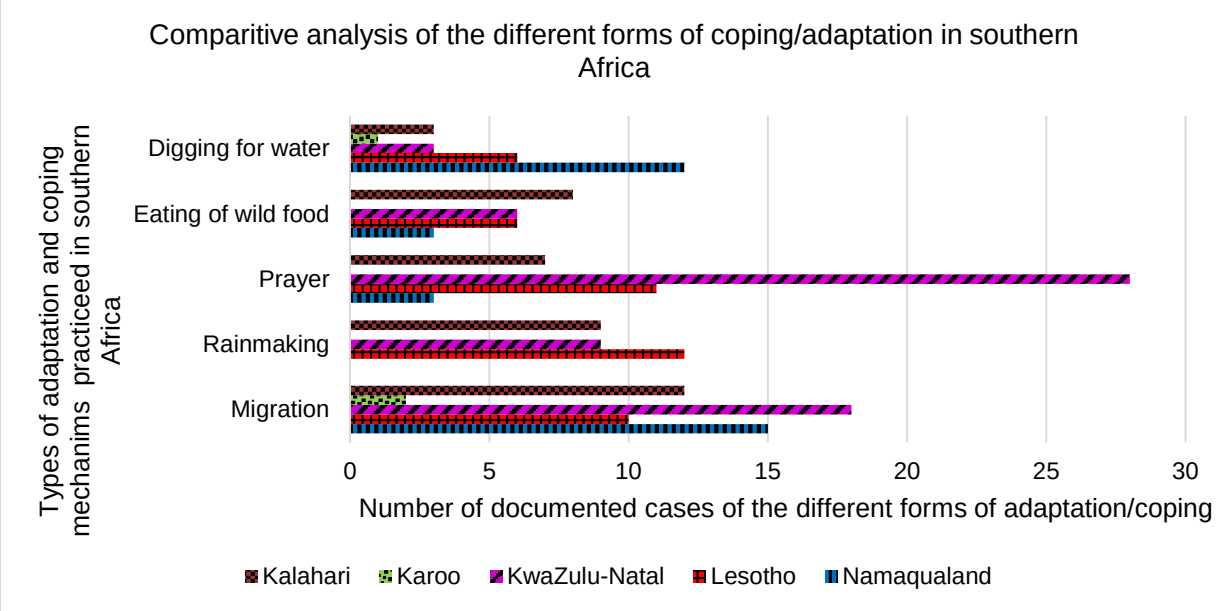

Figure 6-2: Comparing the various coping/adaptation mechanisms in southern Africa during the 19th century

Migrations and rainmaking were most practiced forms of coping in the Kalahari region, while in Lesotho the indigenous people focused their forms of coping mainly on religious responses such as prayer for rains and rainmaking. Eating of wild food was also a common form of coping with famine in the Kalahari, while in regions such as Namaqualand, such practices were not commonly adopted, although there were three documented cases, it didn't appear to be something that the Namaqua's practiced a lot. Similar findings were presented by Hannaford (2018) for the Zambezi-Save area of southern Africa, particularly Sofala and Quelimane,

whereby the gathering of wild plants throughout these regions were a common practice during drought years in the 18th century. Seasons that remained unfavourable in Namaqualand were often coped with through transhumance practices (Kelso, 2010). Transhumance practices, also referred to as seasonal migration of livestock, has been a long-term effective means of escaping unfavourable climate (O'Farrell *et al*., 2009). Such measures were often practiced in Namaqualand, used effectively by the Khoikhoi (O'Farrell *et al*., 2009). The Literature by O'Farrell et al. (2009), corresponds with the findings of this , as documented evidence revealed extensive transhumance practices in Namaqualand during 1835, (Reports of the London Missionary Society, 1835, 96-97) and 1839 (Report of the London Missionary Society, presented at the General Meeting of the Missionary Society, held May 9, 1839, 96-97).

In order to preserve and protect livelihoods and resources, documented evidence for southern Africa revealed that indigenous communities has a wealth of rich, traditional knowledge of responding to climate extremes and instances of environmental change. A common practice amongst southern African communities was rainmaking during the 19th century. Literature by Christian (2014) further points out that rainmaking is important, particular for crop fertility and agriculture. The literature by Christian (2014) further correlates with documented sources in KwaZulu-Natal during 1876 which revealed, that rainmaking occurred due to indigenous communities being unable to plant (USPG E31, J. Jackson, Amanvazi, Zululand, 31 October 1876). Rainmaking typically stood out in extreme dry/drought years. Documented evidence on rainmaking revealed that each region had its own form of offering sacrifices for rain. Rainmaking rituals were purely religious, based on faith and often involved ancestral influences (Akong, 1987), and the rituals also differed between tribes and different cultures or nations (Semenya, 2013). This is evident for southern Africa, with rainmaking practices differing between the Zulu in KwaZulu-Natal and the Basotho in Lesotho. Rainmaking involved animal sacrifices in KwaZulu-Natal, although this has not been documented elsewhere in the Kalahari or Lesotho, the sacrifices of animals were made to invoke the rain god in a hope that rain will be provided (KCM 65607. GARDEN, Capt Robert Jones. Vol. 2: Copy of Miscellaneous Notes and Information 1851-1853). While rainmaking rituals performed in Lesotho included the involvement of principle chiefs of the region, and rather than sacrifices being made indigenous people gathered and sang for rain (KCM 65607. GARDEN, Capt Robert Jones. Vol. 2: Copy of Miscellaneous Notes and Information 1851-1853).

It was a cultural practice and in Lesotho what stood out was that it was disapproved of by missionaries who didn't believe that rain could be provided by a person with powers to invoke the rain god (Little Light of Basutholand No 11 November 1874). Although these cultural forms of coping were taken seriously in various regions in which they were documented, they didn't

prove to always be successful. Compared to Lesotho, rainmaking rituals in KwaZulu-Natal involved more in-depth animal sacrifices and prayers in order to invoke the rain god in a hope that rain will be provided during severe droughts (KCM 65607. GARDEN, Capt Robert Jones. Vol. 2: Copy of Miscellaneous Notes and Information 1851-1853).

Droughts during the 19th century created conditions which resulted in environmental crises, which posed a risk to livelihoods of the people of southern Africa. During such circumstances, migration was therefore seen as an adaptation mechanism with such changing environmental conditions that presented themselves. Amongst some of the common reasons for migration, famine stood out as the main reason as to why indigenous communities in southern Africa migrated during the 19th century (Table 6-1). Migration was a long term response to droughts and resource shortages in southern African communities. Migration in KwaZulu-Natal was typically triggered by impacts such as famines which were the most common impact across most regions triggering migration, major crop failures which were recorded in four years, while common across Lesotho and KwaZulu-Natal were indigenous communities seeking employment due to resource shortages, crop failures and lack of food resources caused through droughts. While in the Kalahari, food security and shortage of food resources promoted communities to leave to surrounding regions in search of food sources.

Table 6-1: Reasons for migration during the 19thcentury across southern Africa

Region	Year	Reason for Migration					
		Famine	**Crop Failures**	**Search of food**	**Locusts**	**Seeking Employment**	**Seeking water**
Kalahari	1846-1847, 1860, 1879						
	1849						
KwaZulu-Natal	1836, 1862, 1872, 1878						
	1882						
	1872						
	1896						
Lesotho	1877						
Namaqualand	1835,1839						

Other common reasons for migration was also loss of income from crop failures which compelled the indigenous population, particularly the younger generation to seek employment and other means of income elsewhere (WMMS SA Synod Minutes FBN4, Mf.186, Bloemfontein District Minutes and Reports, 18 Jan. 1878 Report of the Thaba Nchu Circuit for the year 1877). While interestingly in the Kalahari, the devastating drought in 1849 prompted the movement of entire farms to regions elsewhere in order to secure incomes and crop yields (LMS C 24-1-A H. Helmore Lekatlong 2 January 1849).

Research by O'Farrell *et al*. (2009) highlights that history shows that, social interactions and sharing schemes are crucial for coping with droughts. Drought and climate change affects production systems, with changing production levels and income variability. Documented evidence has shown how droughts have affected livelihoods and the ability to secure incomes. This triggered responses such as migration/population dispersal during the 19th century.

6.1.6 Summary

Documented evidence for the 19th century showed the different impacts across the following regions, Lesotho, Kalahari, Namaqualand, Karoo and KwaZulu-Natal. Although in some instances not all impacts were experienced in the same regions, from documented data, it reveals that KwaZulu-Natal was the region that took longer to recover from most documented impacts than other regions. Although the same impacts were felt across other regions, in comparing all regions, KwaZulu-Natal was documented to have the most impacts regarding famine conditions, locust outbreaks, livestock diseases, human health impacts and water scarcity. While in terms of poverty, the most amount of impacts were recorded in Namaqualand. KwaZulu-Natal, particularly the Zululand area contains a rich amount of historical data, and a significant amount of historical information is widely available for these regions (Klein *et al*., 2016). Such richness of data therefore presents detailed pictures of typical impacts that were recorded throughout the 19th century and allows for investigation of climate-society relationships (Klein *et al*., 2016).

Table 6-2: Comparing the total amount of documented impacts across southern Africa

	Documented Impacts					
Regions	**Water Scarcity**	**Famine**	**Human Health**	**Poverty**	**Locusts**	**Livestock diseases**
Namaqualand	27	4	5	13	7	10
KwaZulu-Natal	34	174	21	2	190	145
Kalahari	23	37	6	6	21	17
Karoo	16	2	10	Insufficient data	116	20
Lesotho	22	60	4	9	73	13

In responding to these impacts, various coping and adaptation techniques were used and explored during the 19th century. In some instances these strategies proved to be successful like in the case of rainmaking which occurred in 1874, where following a ritual, the drought was eventually broken up with plentiful rains (Little Light of Basutoland No 12 December 1874). Similarly in KwaZulu-Natal, rainmaking was a success during the year 1878, when the drought was broke up after a ceremony (Natal Witness, 14 November 1878). Despite the hardships felt in KwaZulu-Natal, the faith of the indigenous communities in this region remained strong and they continued to worship and show strong beliefs towards local rain

doctors. Coping mechanisms such as migration were difficult to trace and determine if they were successful or not.

Other successful adaptation techniques involved changes in agro-pastoral process and land use changes. Indigenous communities in KwaZulu-Natal for instance documented advance preparation for winter months by stocking up hay in order to sustain cattle until the next season (Natal Witness 28 May 1852), which highlighted that they prepared themselves ahead of any resource scarcity should there be lack of hay available to feed their cattle until the next season. Other successful measures in KwaZulu-Natal included the adoption of irrigation techniques which will assist farmers during drought months (Natal Witness 10 January 1899)

7 Conclusion

The primary aim of this study was to use existing 19th century chronologies developed for southern Africa and using this data, determine the social and environmental consequences following events of droughts, and floods. Where possible, this research also looked at El Niño years. El Niño conditions had a more consistent, controlling effect on rainfall during the 19th century as compared to La Niña conditions (Nash *et al*., 2015).In addition, the relationships between ENSO and rainfall patterns are also difficult with various temporal and spatial changes made throughout various seasons (Kelso and Vogel, 2007). During periods where there are relatively few meteorological records that are reliable, it becomes scientifically problematic when linking ENSO to rainfall (Kelso and Vogel, 2007).

In addition, this study also examined the various adaptation and coping methods that were developed in southern Africa to cope with such impacts and consequences. The use of the existing chronologies developed for southern Africa addressed the aim of the study and information was gathered for the various themes on droughts, famines, poverty, human health impacts, livestock diseases and locusts. .This study also addressed the objectives of the project which highlighted the impacts on livelihoods, health, illnesses, epidemics, poverty, economic impacts and environmental. In addition, various responses and coping mechanism were documented and discussed to show how society was responding toward such impacts. This study also contributes towards historic climate research which studies past adaptation by sharing lessons learnt and establishing possible gaps.

There were five key research questions for this dissertation, each question consisting of several sub-questions noted in order to fully answer the primary question. In this section, only the primary question will be presented but the answers will take into consideration all sub-questions

Primary question 1: Using existing recorded data for historical droughts and wet periods, what were the climate extremes during these years and what significant impacts were recorded about these climate extremes across various regions of southern Africa?

Recorded data highlighted that droughts were typically the major climate extreme which impacted on various sectors as well as social livelihoods. Where possible such extremes were also linked to El Niño type conditions, although tracking La Niña events was difficult, as verification of the records of such events are a challenge due to lack of coverage (Gergis and Fowler, 2006).

Primary question 2: What were some of the societal consequences of these impacts across various regions of southern Africa for common periods?

The historical data contained a wealth of information that was relevant to impacts and consequences across the various regions. By exploring this data, typical consequences that have been recorded and discussed included, health impacts, poverty, locust outbreaks, livestock diseases, famines, water scarcity, droughts, and economic impacts.

Primary question 3: By investigating societal consequences, how long did certain types of consequence's last for?
The section 5.6.2 highlights a summary of all impacts and how long they lasted for in specific regions. In addition, recovery periods for each impact are shown in this section.

Primary question 4: In comparing the various sub-regions of southern Africa, what are the different recovery periods for these regions?

The historical investigation of determining how long certain consequences lasted and periods of recovery for each region were determined by the number of counts and recorded during specific years. Typically the years during which a region did not experience a typical impact was viewed as a recovery period. Although some regions would typically have more impacts in one year compared to another year where there are no documented records of impacts, it remains difficult to portray such information accurately. Although there might not be any mentioned impacts for some regions does not typically mean that that region did not face those impacts. Some authors of diaries and journals may not have recorded every single impact or event. Despite this, impact duration and recovery times were presented for each region, showing how long certain trends lasted for and where regions were able to recover much

quicker than other regions. The trends also indicate that KwaZulu-Natal was slower to recover from other regions, although limitations in data could also imply that although certain impacts were shown for specific years only, they could have persisted longer in other regions.

Primary question 5: Is it possible to identify and separate coping and adaptation mechanisms during the 19th century in southern Africa?

Various forms of coping and adaptation were highlighted in documented data. Typically these forms of adaptation included rainmaking, prayer for rains, digging for water resources, migration and population dispersal and techniques in agro pastoral process involving landscape changes and land use changes.

7.1 Recommendations for consideration into future work

This study explored the social and environmental consequences of climate extremes for various regions in southern Africa. The work built on existing published work that took place in the region. There is relatively new work that has been done in southern Africa which includes the study in Namibia exploring documentary based chronologies for central Namibia (Grab and Zumthurm, 2018), in Malawi which looks at including the establishment of rainfall variability in Malawi during the 19th century (Nash *et al*., 2018) and climate variability in Madagascar islands during the 19th century (Nash, 2012). Such studies could also further be broadened and included to look at the social and environmental consequences in these regions and draw a comparison to the findings of this research. The need for climate-society relationships in future historical climatology will also be meaningful to draw relationships between society and the environment, considering that it is critical to understand how past societies coped in order to assist future policy makers to develop strategies that are aimed at social resilience and address challenges that are occurring as a result if environmental change.

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WMMS SA CORRESPONDENCE FBN4 Mf 118, R. Giddy, Thaba Nchu, 28 December 1840

WMMS SA CORRESPONDENCE FBN4 Mf 120, J. Cameron, Plaatberg, 21 February 1842

WMMS SA CORRESPONDENCE FBN4 Mf 123. R. Giddy, Thaba Nchu, 25 November 1843

WMMS SA CORRESPONDENCE FBN4 Mf 130. J. Cameron, Thaba Nchu, 11 January 1851

WMMS SA CORRESPONDENCE FBN4 Mf 146. A. Brigg, Wittebergen, 10 May 1871

WMMS SA CORRESPONDENCE FBN5 Mf 179. A. Brigg, Wittebergen, 20 July 1866

WMMS SA CORRESPONDENCE FBN5 Mf 185. G. Baker, Thaba Nchu, 3 June 1867

WMMS SA CORRESPONDENCE FBN6 Mf 205. J. Daniel, Thaba Nchu, 22 April 1881

WMMS SA CORRESPONDENCE FBN6 Mf 211. G. Waterhouse, Wittebergen, 6 July 1882

WMMS SA Synod Minutes FBN2, Mf.66, Northern District Minutes and Reports, 26 Oct. 1859

WMMS SA Synod Minutes FBN4, Mf.186, Bloemfontein District Minutes and Reports, 18 Jan. 1878 Report of the Thaba Nchu Circuit for the year 1877

WMMS SA CORRESPONDENCE FBN6 Mf 205. J. Daniel, Thaba Nchu, 22 April 1881

Appendix A-Database of Information

Example of an excel spreadsheet used to categorize information on climate/impacts and responses

Year	Region	Date	Impacts /Climatic Occurrence	Consequences	Responses
1830	Moffat/Lattakoo		Fine rains	Country Completeley drenched, Abundant crops	
1830	Lattakoo		Fine rains	Getting stuck in mud	
1830	Kuruman			Gardnes deemed with plenty	
1831	Lattakoo		Dryness of the season	Hunger will be felt	
1831		Oct-15	Heavy rains	Lake unusually high	
1831		Late April	Abundant Rains	Great cold was experienced	
1831			drought*		
1832	Kuruman	Feb-22		excessivley bad quality of pasture	
1832				Failure of crops	
1833	Lattakoo	Jan-10	drought (during season)	Suffering cattle	
1833	Kuruman	Sep-30	Drought	Dry-Need for irrigation	
1833	Boetsap	Dec-02	Exceedingly hot	Gardens scorched up and ready to die	
1834	Kuruman				
1834	Kuruman	Jan-31	Great Drought	every green thing is burnt up in the sun, inhabitants suffering for want of fruit of the field	
1834	Kuruman	Feb-03	Drought	Loss of cattle and scarcity of milk	
1834	Kuruman	Sep-03	Drought		Migration
1834	Lattakoo		Drought		Pray for rain?
1835	Various		Rained Much, still showery		?
1835			Many showers, place is cold and dumpy		
1835		Jun-13	heavy Rain		
1835		Jun-14	Wet and cold		
1835		Jun-17	Damp, cold and Chilly		
1835		Jun-22	Cloudy, Rain and very cold		
1835		Jun-12	Much Rain		
1835		May-05	Abundance of rain		
1835	Umpukani	Jul-10	Heavy rains		
1835	Umpukani	Sep-20			
1836	Kuruman	Jul-18	Drought	People are improverised, Thirsty	
				Outbreak of Locusts-destruction to crops and gardens	
1836	Edwards	Jul-22	Drought	Small Crop produce that year	
1837	Kuruman	Nov-03	No rain	Uncommonly warm season	
1838		Jul-02	Abundant rains		
1838	Kuruman	Jul-07	Abundant rains	reduced her strenght	
1838	Kuruman	Dec-13	Drought	Outbreak of cattle sickness	
1839			Drought	Famine and hunger	
				Frost-Ruined corn	
1840	Lattakoo	Mar-09			People taking care of cornfields
1841	Kuruman	Apr-08	Heavy rains	Food In Abundance	
1841	Kuruman	Dec-08		Water Scarcity for domestic use	River/Water Course in terms of heavy rains
1841	Kuruman	Dec-02	Dry Climate	Painful to females,hot winds blow,headchaes, sideaches,and sore eyes	
1841	Kuruman	Dec-22		Water Scarcity to the North	Game-large and small serve as a means of food
1841	Kuruman	Dec-22			Irrigation large valley with a founatin.
1842	Kuruman	Apr-14			Rainmaking (enchantment)

Example of an excel data base created mapping all impacts for the different regions during the 19th century

